FINAL REPORT

PRELIMINARY PLANNING STUDY

WILLOW CREEK BASIN - INVENTORY OF STORAGE SITES

FOR

ALBERTA ENVIRONMENT

PLANNING DIVISION

JUNE 4, 1984

KLOHN LEONOFF
CONSULTING ENGINEERS

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

LIST OF DRAWINGS

1.0 INTRODUCTION

The objective of this preliminary planning study was to identify potential on-stream and off-stream water storage sites in the Willow Creek drainage basin and to determine the order of magnitude costs to develop the sites. The study was, in essence, an office study based on available information including previous reports, topographic maps, airphotos, streamflow data, hydrological reports and geological reports, augmented by a site reconnaissance.

The scope of work included the following items as outlined in the attached Terms of Reference in Appendix I:

- identify natural water yield potential;
- identify on-stream and off-stream storage sites;
- identify maximum reservoir capacity and dam height of selected reservoir sites;
- preliminary design and cost estimate;
- comparison of selected sites based on water supply capability, capital and annual costs, operating considerations, suitability for municipal water supply and streamflow augmentation, environmental impacts and land damages;
- ranking of selected sites.

It was agreed with Alberta Environment that a total of six potential storage sites would be selected from those identified in the initial stages of the study for more detailed assessment and comparison. The locations of the six selected sites are shown on Figure 1. Several other potential sites are also shown for possible future reference during final design but are not included in the detailed comparison of this report.

Site 2 comprising of a diversion structure on Willow Creek and a reservoir in Pine Coulee, was previously studied by P.F.R.A. in the late 1950's; however, their study was never completed as a result of the decision to construct the Chain Lakes Reservoir. The mapping and

geotechnical information gathered by P.F.R.A. was made available to Klohn Leonoff Ltd. for this study. Consequently the assessment of Site 2 was based on much better site data than any of the other sites.

2.0 METHODOLOGY

2.1 Sources of Information

A list of references for all the topographic maps, airphoto coverage, reports, land classification maps, geology maps and reports, hydrogeology maps and previous geotechnical investigations, used in this study, are provided in Appendix II. In addition to these sources of information one aerial site reconnaissance was made to gather additional geological and topographical details.

2.2 Hydrology Studies

A hydrology study was carried out to determine the following key parameters.

a) Annual water yield.
b) Target storage capacity required to provide flow regulation for 60% of mean annual runoff.
c) Spillway design floods.
d) Construction diversion design floods.

The study identified these parameters in terms of catchment area so that they could be estimated for any selected site, depending on the catchment area and location within the Willow Creek Basin. The analysis, conclusions and general discussion of the surface water hydrology of the area, are reported in Appendix III.

The criteria of 60% flow regulation was selected to identify a maximum size of reservoir at any location, for preliminary comparison. The required reservoir size would be reviewed during the detailed design stage, once water demands are estimated.

The design hydrologic parameters for each of the six sites, as given on the summary graphs in Appendix III, are given below:

Site No.	Mean Annual Flow m^3/s	Mean Annual Runoff dam^3	Target Storage Capacity* dam^3	Design Spillway Capacity m^3/s	Construction Diversion Capacity m^3/s
1	3.39	107,000	76,000	900	270
2	3.36**	106,000**	73,000**	-+	3+
3	3.04	96,000	59,000	1,000	190
4	1.60	50,500	30,000	530	120
5	1.32	41,500	25,000	450	100
6	0.73	23,000	19,500	380	18

* Regulation of 60% of mean annual runoff.

** Considering Willow Creek flow at mouth of Pine Creek.

+ Considering Pine Coulee flow.

The target reservoir storage capacity, based on flow regulation of 60% of mean annual runoff, was identified for each site assuming no flow regulation by Chain Lakes. If the allowable live Storage capaicty of that reservoir were incorporated, the target reservoir storage capacity for each of the downstream potential reservoirs would be smaller by an equal amount. According to present Chain Lakes reservoir operating criteria, approximately 6000 dam^3 of storage, which is equivalent to a 1.5 m (5 foot) reservoir drawdown, is used for flow regulation.

2.3 Site Selection

Twenty-three possible reservoir sites were initially selected based on 1:50,000 scale NTS mapping. Approximate dam embankment quantities were calculated, based on this mapping, for the target reservoir storage values calculated in the hydrology study.

The sites were then listed in order of the ratio of reservoir capacity to embankment volume. Other factors such as flooded area, flooded farmsteads, length of required road relocation and flooded pipelines were identified for each site. This information was used to screen the sites in conjunction with Alberta Environment. As a result 13 sites were selected for aerial reconnaissance and further comparison.

The aerial reconnaissance was undertaken on March 9, 1984. Based on the additional site specific geological and topographical observations made during that reconnaissance, 6 of the 13 sites were selected in consultation with Alberta Environment. The rational for the final site selection was detailed in a progress report dated March 19, 1984 provided in Appendix IV of this report.

As indicated in that progress report, Site 6 was included in the final selection so that the more detailed assessment and comparison would include one site in the southern portion of the Willow Creek Basin.

Site 2 is the only off-stream site considered in this study as no other suitable off-stream sites were identified. Storage sites were considered on many of the tributary creeks to Willow Creek but the ratios of reservoir volume to dam volume were so low that these sites were eliminated early in the study.

The plains east of Willow Creek were also inspected during the site reconnaissance for off-stream storage sites that might serve as municipal water supply reservoirs supplied by pumps from Willow Creek. A number of natural depressions and potholes were examined; however, it appeared that off-stream storage could only be developed by building perimeter dykes to raise the potential water depth and minimize the flooded land area.

In addition to the six selected sites, there are other sites whose potential for development appeared nearly equal to the selected sites during the site selection phase of this study. The location of these sites are identified on Figure 1 so that they may be re-considered if necessary at a later stage.

2.4 Conceptual Design Parameters

2.4.1 Reservoir Capacity

The design reservoir capacity was determined by the lesser of the following criteria:

a) Storage capacity based on a target flow regulation of 60% of mean annual runoff.

b) Physical maximum practical storage capacity of any site as determined by the height of the valley walls less freeboard.

Reservoir capacity and area curves were calculated for four of the six selected sites based on a combination of the following:

- aerial photos to determine valley bottom width
- 1:50,000 scale NTS mapping to determine valley gradient
- aerial photos (by parallax bar) to estimate height of the valley walls.
- field observations (by range finder and clinometer) to estimate slope of valley walls.

For Site 2 at Pine Coulee, the P.F.R.A. detailed topography with 10 foot contours, was used. For Site 4 where the valley walls are not nearly as steep as at the other sites, the reservoir area and capacity curves had to be estimated using the 1:50,000 topographic maps. The storage capacity curve for this site is therefore considered to be the least accurate.

2.4.2 Dams

Geotechnical assessments for dam design were made on the basis of the following data:

- site reconnaissance
- geology and hydrogeology maps and reports
- detailed drill hole logs at Site 2 - Pine Coulee from P.F.R.A.
- Air photo interpretation
- drill hole logs on Willow Creek near the Claresholm water supply intake, from Alberta Environment
- subsoil data at the north and south dam of the Chain Lakes Reservoir project, as outlined in the design report

Earthfill dams were selected for each of the sites except Site 3 where a rockfill dam with an impervious core, was selected. Upstream dam side slopes vary from 1V:2.5H to 1V:4H depending on zoning, and expected foundation conditions. Downstream side slopes vary from 1V:2H to 1V:3H. A 6 m minimum crest width and 3 m freeboard allowance was provided for each main dam.

2.4.3 Spillways

Flipbucket type spillways were selected for each site where rock was expected to provide a suitable foundation; otherwise hydraulic jump stilling basins, were selected.

The criteria for selecting the design spillway capacity was based on the Dam Safety Guidelines by the Dam Safety Branch of Alberta Environment as outlined Below:

Reservoir Capacity	Design Flood
1,000 - 50,000 dam^3	0.5 PMF
> 50,000 dam^3	0.75 PMF

The probable maximum flood (PMF) estimates are based on envelope curves from the Saskatchewan Nelson Basin Board Studies and are reproduced and discussed in Appendix III.

2.4.4 Construction Diversions and Low Level Outlets

Tunnel diversions in combination with low level outlets were selected for five of the sites where the risk of relatively large floods is significant. However, a cut and cover low level conduit was selected for Site 2 because of the relatively low flood flow potential from its natural catchment. The required construction diversion capacity for each site was assumed to be the 25 year flood peak. The 25 year flood potential on the Willow Creek Basin was derived in the hydrology study and is presented in Appendix III in terms of catchment area.

2.4.5 Water Supply

Each of the sites are designed to provide flow regulation by controlled release through the low level outlet. Gravity diversion to other off-stream locations would not be feasible at any of the sites for any significant diversion.

2.5 Basis of Cost Estimates

Considering the very preliminary nature of this study, the cost estimates presented herein were determined from gross volumes, design capacities and major dimensions. Costs were based mainly on estimates made for other projects which have been studied in more detail and recent construction costs of similar projects. These costs were adjusted to reflect 1984 price levels. The estimated project costs presented herein, should be used only for comparing the six sites, and should be treated as order of magnitude type of estimates.

The major cost items and basis of unit costs are outlined below:

i) Dam Embankment

The total cost of the earthfill dams was calculated by multiplying the total dam volume by a unit cost of $\$6.50/m^3$. This unit cost was selected based on 22 other recent embankment projects.

The total cost of the rockfill dam with impervious core was calculated by multiplying the total dam volume by a unit cost of $\$9.00/m^3$.

ii) Spillway

The spillway costs were extrapolated from the known or estimated project costs of eleven other spillway projects. The extrapolation was based on two parameters; the spillway length and design flow capacity.

iii) Diversion Tunnel and Low Level Outlet

The cost of diversion tunnel and low level outlet were similarly determined based on eight other projects. The total costs were extrapolated based on the tunnel length and design flow capacity.

iv) Reservoir Damages

The assumed costs of reservoir damages are itemized below.

Road Relocations:	
minor gravel road	$ 50,000/km
major gravel road	$100,000/km
Bridges:	
across Willow Creek	$500,000
across Trout Creek	$300,000

Land:	
irrigated land	$5,000/ha
cultivated dryland	$2,500/ha
range pasture	$1,200/ha
valley walls	$ 750/ha
Land Clearing:	
Clearing	$1,800/ha
Farmsteads:	
large farmstead	$200,000
intermediate farmstead	$100,000
small farmstead	$ 50,000

A 40% contingency was added to each of the above to account for engineering, land conveyancing and items unaccounted for at this level of analysis.

2.6 Environmental Aspects

Various environmental and resource land classifications at each site are identified on Table 3. The classifications were determined from the published maps listed in Appendix II.

3.0 POTENTIAL STORAGE SITES

3.1 General

The location of each site is shown on Figure 1. Figures 2 to 14 show the following items for each project site:

- the reservoir plan area
- the reservoir area curves
- the reservoir capacity curves
- the advantages and disadvantages of each site
- the damsite
- a typical dam section
- a conceptual spillway section

Table 1 provides the pertinent project data for each site including location, catchment area, flow regulation potential, mean annual flow, storage capacity and details of the dam, spillway, construction diversion and low level outlet. Table 2 provides a summary comparison of each site in terms of hydrology, dam foundation conditions, structures, reservoir damages, unit cost, and environmental classification. Table 3 lists the land classification as determined from the various environmental and resource land classification maps. Table 4 provides a summary of the estimated project costs.

3.2 Site 1 - Willow Creek Near Claresholm

The damsite is on Willow Creek about 8 km northwest of Claresholm and about 7 km downstream of the confluence of Pine Creek with Willow Creek. The reservoir location and details are shown on Figure 2 and the general arrangement, including damsite, spillway, construction diversion, and low level outlet is shown on Figure 3.

The design reservoir capacity of 39,000 dam^3 is limited by the height of the valley walls. The flow regulation capability is 50% of mean annual runoff which is somewhat less than the 60% targeted, but nevertheless quite significant.

The dam foundation on the valley floor is expected to be composed of pervious layers of sand/gravel, interbedded with silt and clay. The left abutment is composed of sandstone/shale bedrock to about half the valley wall height, overlain by glacial till. The right abutment appears to be in till to the valley bottom. Glacio-lacustrine silts, sands and clays are expected to overlie the till on both abutments. As shown on Figure 3, a slurry cutoff wall is provided beneath the dam to control seepage. The dam side slopes are relatively shallow for stability.

The reservoir will flood one farmstead, 215 ha of private land and 60 ha of crown land. No road relocation would be required. The reservoir area is classified as being a Wildlife Key Area for mule deer and white tailed deer (Fish and Wildlife Division, 1981). Accoridng to the Fish Resource Maps (Fish and Wildlife Division, 1982), Willow Creek in the vicinity is populated by suckers.

3.3 Site 2 - Pine Coulee

The damsite is located in Pine Coulee near Willow Creek. The reservoir location and details are shown on Figure 4. The scheme requires a 6 m high diversion weir on Willow Creek to divert streamflow into a diversion channel to the reservoir located in Pine Coulee. An inlet chute would be required at the end of the diversion channel. Controlled releases from the reservoir to Willow Creek would be provided by a low level conduit through the left dam abutment. The general arrangement of the scheme is shown on Figure 5 and typical sections through the various structures are shown on Figure 6.

The reservoir would flood most of Pine Coulee. The design storage capacity of 50,500 dam^3 is limited by the height of the valley walls although some containment dyking is required for this volume of storage as shown on Figure 5. Consequently this reservoir provides less than the targeted flow regulation capability of 60% of mean annual runoff. Nevertheless, the regulated release rates would be higher than most of the other sites, as show on Table 1.

This site has the advantage of requiring no major service spillway or diversion works. Diversion during construction would be handled by the low level outlet constructed in advance. The project design flood could be handled either by storage above full supply level (FSL) or by reverse flow through the diversion channel to the emergency spillway in the bank of the channel.

The diversion channel from Willow Creek would require substantial excavation of about 700,000 m^3, however, the excavation costs would be offset by use of the excavated material in the dam and channel embankments.

The dam abutments are composed primarily of till overlain by a variable thickness of glacio-lacustrine sands, silts and clays. Bedrock in the abutments occurs about 7 m above valley bottom but is presently covered by colluvium.

The dam foundation on the valley floor appears to be interbedded silts and clays with some sand layers. The deposit appears to be normally consolidated. These foundation conditions will require a dam with relatively flat slopes for stability and provision for relatively large settlements. However, seepage cutoff requirements are anticipated to be minimal.

As shown on Table 2, the reservoir will flood five farmsteads, one of which is apparently abandoned. Three of these farmsteads are relatively small consisting only of one or two small buildings. There is also one large farmstead located immediately below the damsite. For purposes of the cost estimate, it is assumed that this farmstead will have to be relocated.

The reservoir also floods four roads which presently cross the coulee. It is assumed for purposes of the cost estimate, that the southerly road crossing will be re-routed across the dam, that a major causeway will be built for the next road crossing north of the dam and that a minor raising of the road embankment will be required for the most northerly crossing. It is assumed that the third crossing north of the damsite will be abandoned.

The reservoir will flood 540 ha of private land and require 6.5 km of road relocation. The flooded area is not classified as a Wildlife

Key Area for any species. (Fish and Wildlife Division, 1981). The reservoir would not have an adverse impact on the Fish resource as Pine Creek is ephermeral and thus does not provide a fish habitat.

3.4 Site 3 - Willow Creek Near Lane Creek

The damsite is located on Willow Creek about 2 km upstream of the confluence with Lane Creek. The reservoir location and details are shown on Figure 7 and the general arrangement, including the damsite spillway, construction diversion and low level outlet is shown on Figure 8.

The reservoir capacity of 59,000 dam^3 is sized for the full targeted flow regulation of 60% of mean annual runoff. The potential regulated release rate is higher than at any of the other sites (2.44/1.22 m^3/s, summer/winter).

The damsite is in a narrow rock gorge with abutments composed mainly of sandstone. The bedrock is jointed with bedding planes and exhibits some weathering. The bedrock is overlain by till. Bedrock on the valley floor is expected to be close to the riverbed and, is also expected to exhibit some surficial weathering. These foundation conditions, though excellent with regard to stability considerations, are expected to require a grout curtain across the valley floor and on the abutments to control seepage.

This site may lend itself to the use of a rockfill concrete faced dam which could be more economical than the rockfill embankment selected for the purposes of this report. However, for this level of study the rockfill shell and impervious core section design was selected for uniformity and comparison purposes.

The narrow valley gives a small dam volume relative to the reservoir storage capacity such that the ratio of reservoir volume to dam volume is the second highest of the sites considered.

Reservoir damages are comparatively small at this site. The reservoir will flood one large farmstead, 260 ha of private land and 35 ha of crown land.

The reservoir area is not classified as a Wildlife Key Area (Fish and Wildlife Division, 1981) but Willow Creek in that vicinity supports rainbow trout, eastern brook trout, mountain whitefish and suckers (Fish and Wildlife Division, 1982).

3.5 Site 4 - Willow Creek Below Chain Lakes

The damsite is located on Willow Creek, about 2 km upstream from the confluence with South Willow Creek, and about 10 km southeast of Chain Lakes Reservoir. The reservoir location and details are shown on Figure 9 and the general arrangement including the damsite, spillway, construction diversion and low level outlet is shown on Figure 10.

In addition to the main dam situated in a narrow rock gorge, a small dyke about 2 m high, will be required across a saddle to the west of the dam. This site requires quite a small embankment volume relative to reservoir storage. The ratio of reservoir volume to dam volume is the highest of the sites studied.

The reservoir capacity of 30,000 dam^3 is sized for the full targeted flow regulation of 60% of mean annual runoff. The potential regulated release rate is somewhat lower than Site 1, 2 and 3 (1.28/0.64 m^3/s, summer/winter).

Both abutments of the main dam are expected to be in bedrock to the dam crest level. Bedrock is also assumed to occur close to the riverbed level. The bedrock is expected to be jointed sandstone with bedding planes, becoming tighter with depth from the surface. The bedrock surface will be weathered, particularly along bedding planes. The foundation conditions are assumed to be inferior to Site

3 and an earthfill dam has been selected accordingly. If actual foundation conditions are better, a rockfill dam with impervious core like Site 3 Would be more suitable.

The reservoir damages at this site would be fairly significant. Two intermediate sized farmsteads will be flooded and 6.5 km of road will have to be relocated involving a bridge across Willow Creek. About 400 ha of private farmland would be flooded.

The flooded area is not classified as a Wildlife Key Area (Fish and Wildlife Division, 1981), however, Willow Creek in this vicinity provides habitat for rainbow trout, eastern brook trout, mountain whitefish and suckers (Fish and Wildlife Division, 1982).

3.6 Site 5 - South Willow Creek

The damsite is located on South Willow Creek, about 3 km upstream of the confluence with Willow Creek. The reservoir location and details are shown on Figure 11 and the general arrangement including the damsite, spillway, construction diversion and low level outlet is shown on Figure 12.

The reservoir capacity of 25,000 dam^3 is sized for the full targeted flow regulation of 60% of mean annual runoff. The potential regulated release rate is lower than sites 1 to 4 (1.06/0.53 m^3/s, summer/winter).

The unit cost of water storage at this site is higher than any of the other sites.

The left abutment is bedrock and is expected to be composed of interbedded sandstone and shale with some weathering especially at joints and bedding planes. The right abutment is believed to consist of glacio-lacustrine silts and clays overlying moraine (till). The dam foundation on the valley floor is expected to be composed of gravel interbedded with silts and sand.

These foundation conditions will require seepage control measures on the left abutment and valley floor.

The reservoir damages are comparatively small at this site. The reservoir will flood one small farmstead and 200 ha of private land. About 1.6 km of road will have to be relocated.

The reservoir area is classified as being a Wildlife Key Area for moose (Fish and Wildlife Division, 1981) and South Willow Creek is classified as supporting rainbow trout (Fish and Wildlife, 1982).

3.7 Site 6 - Trout Creek

The damsite is located on Trout Creek, about 6 km west of the confluence of Trout Creek and Willow Creek. The reservoir location and details are shown on Figure 13 and the general arrangement including the damsite, spillway, construction diversion and low level outlet is shown on Figure 14.

The reservoir storage capacity of 12,000 dam^3 is limited by the height of valley walls and thus provides less than the targeted flow regulation of 60% mean annual runoff. The reservoir is the smallest of all the sites considered and provides the least amount of flow regulation. The ratio of reservoir volume to dam volume is relatively low.

Both dam abutments are bedrock overlain by till and a surficial layer of glacio-lacustrine silts, sands and clay. Colluvium composed of a mixture of silts, sands and gravels, occurs at the base of the slope, particularly at the right abutment. The bedrock is expected to be jointed with bedding planes, exhibiting weathering especially along bedding planes. The valley floor is expected to consist of sands and gravels, interbedded with silts and sand. These foundation conditions will require a seepage cutoff to bedrock on the valley floor and a grout curtain at the abutments.

Reservoir damages appear to be minimal. The reservoir will flood about 130 ha of private land but will not flood any farmsteads and will not require any road relocations.

There may be a significant environmental impact as the area is classified as a Wildlife Key Area for great blue heron, mule deer and white tailed deer (Fish and Wildlife Division, 1981). Trout Creek is classified as supporting rainbow trout, cutthroat trout and suckers (Fish and Wildlife Division, 1982).

4.0 SUMMARY AND CONCLUSIONS

This study was in essence a "desk top" study to identify and compare potential on-stream and off-stream reservoir sites in the Willow Creek Basin.

Since water supply requirements are not known in the basin, a criterion for flow regulation was set at 60% of the mean annual flow occuring at each potential site, in order to assess reservoir capacity requirements and height of dams, etc.

Many sites were initially identified but upon more detailed review and site reconnaissance, these were reduced to six sites for purposes of this report. Site 2 is the only site which is not an "on-stream site" in the true sense, as it involves a diversion structure and channel from Willow Creek to a reservoir in Pine Coulee. The coulee has a relatively small catchment area and does not require a major spillway or diversion structure. Site 6 on Trout Creek was included in order to identify the costs and degree of flow regulation potential on Trout Creek. Though this site appears to be a possible dam site, its storage capacity and flow regulation capability is much smaller than any of the other sites, and the unit cost of storage is relatively high.

Potential sites for "off-stream" storage were sought both during the initial review of topographic mapping and during the aerial reconnaissance. However, no significant site was identified other than the Pine Coulee Site. Mud Lake has been identified and well documented in previous reports for off-stream storage for the LNID and has therefore not been addressed in this report.

It would appear that if a small, local demand is identified, pumped off-stream storage lagoons will be the most economical alternative as opposed to on-stream storage.

The environmental impact of each site has been assessed in terms of various classifications derived from published maps. As indicated in Table 3, the capability for waterfowl, outdoor recreation, forestry and agriculture is limited at each site. On the other hand, the reservoir area at Sites 1, 5 and 6 are classified as a Wildlife Key Area for one or more species of Ungulates and Colonial Nesters. Also one or more species of sport fish and presently populated Trout Creek, South Willow Creek and the upper reaches of Willow Creek, in the vicinity of Sites 3, 4, 5 and 6 as indicated on Table 3. However, only suckers occur at Site 1 and no fish presently occur above Site 2 in Pine Creek.

The six sites examined have been "ranked" from various perspectives as shown in Table 5 below. These are somewhat arbitrary rankings and subject to review upon further study. If should be noted that Sites 2 and 3 provide the best flow regulation capability enabling controlled releases in the summer and winter of 2.4 m^3/s and 1.2 m^3/s respectively. Relatively high flow regulation capability is also provided by Site 1.

TABLE 5

PRELIMINARY RANKING

Site No.	Unit Cost of Storage	Flow Regulation	Location* Downstream	Reservoir Damages	Overall Rank
1	5	3	1	3	4
2	2	1	2	6	1
3	1	1	3	4	1
4	3	4	4	5	3
5	6	5	5	2	5
6	4	6	N.A.	1	6

* It is assumed that a site located further downstream is preferable as it would be closer to the likely source of winter demand and the outflow would be less likely to freeze up during extremely cold winters.

Of the six sites it would appear that Sites 2, 3 and 4 are the most suitable. Of these, Sites 2 and 3 appear to have the best potential. Site 2 may have a greater sociological impact and Site 3 may have a greater environmental impact.

The cost of each project was plotted on Figure 15 for comparison with other projects in Southern Alberta. The reservoir cost curves on Figure 15 were previously derived by Klohn Leonoff (see reference in Appendix II) in conjunction with the South Saskatchewan River Basin Planning Program. The comparison is quite good considering the level and accuracy of the study and that of the cost curves.

5.0 RECOMMENDATIONS

In carrying out this preliminary study it became evident that additional information would be useful in assessing the basin storage potential and the desirable location of that storage. In this regard the following recommendations are made:

a) A study should be carried out to determine existing and potential water supply requirements within the basin including municipal, farm, industry and environmental needs.

b) This preliminary planning study should be reviewed after the water supply demands are identified to ascertain the most suitable sites for meeting the basin water supply demands. This review should include alternate means of meeting site specific demands such as small off-stream storages or groundwater sources.

c) Further topographic mapping and a limited geotechnical exploration program should be carried out for those sites which are found to meet the demand requirements.

d) A more detailed study should be undertaken of selected sites involving more accurate layouts and quantities, to more closely define project costs.

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CONSULTING ENGINEERS

OUR FILE: PA 1956.104

June 4, 1984

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Mr. L.K. Szojka, P.Eng.
Oldman River Basin Planner

Willow Creek Basin
Inventory of Storage Sites - Final Report

Dear Mr. Szojka:

We take pleasure in submitting the final report for the Willow Creek Basin Inventory of Storage Sites. As outlined in the report, two potential sites have been identified that have very similar benefits for water management in the Willow Creek watershed but are very different in concept. In one case, Site No. 2, a diversion of water from Willow Creek into Pine Coulee forms the basis of the concept; whereas, the other site, Site No. 3, which is further upstream, incorporates an onstream storage reservoir with the associated spillway and construction diversion works. Both of these potential storage sites have been equally ranked as it was not possible to differentiate between them based on the findings of this study.

We would like to extend our appreciation for the excellent co-operation afforded to us by yourself and Messrs S. Larson & R. Bennett. In addition we would also like to recognize the co-operation provided by the Calgary office of the P.F.R.A. with respect to Site No. 2 which had been studied by them in the 1950's.

If you have any questions or require any clarification of this report we would be pleased to meet with you at your convenience.

Yours very truly,

KLOHN LEONOFF LTD.

R.B. ELSON, P. Eng.
Manager, Water Resources Division

RBE/sh

SITE NO.	CREEK	LOCATION OF DAM	CATCHMENT AREA Km^3	RESERVOIR AREA ha	FLOW REGULATION[1] SUMMER/WINTER m^3/s	MEAN ANNUAL RUNOFF dam^3	STORAGE[2] CAPACITY dam^3	DAM[2] HEIGHT m	DAM[2] LENGTH m	DAM[2] VOL da
1	Willow	12-13-28-W4	1136	285	2.26/1.13	107,000	39,000	27	460	1,1
2	Pine	34-13-28-W4	109 natural 1065 with diversion	540	2.42/1.21	106,000	50,500	21	480	1,7 d a dy
3	Willow	2-14-30-W4	680	295	2.44/1.22	96,000	59,000	46	200	4
4	Willow	15-14-1-W5	355	400	1.28/0.64	50,500	30,000	24	170	1
5	South Willow	5-14-1-W5	258	200	1.06/0.53	41,500	25,000	29	610	
6	Trout	34-11-28-W4	420	130	0.48/.24 Approx.	23,000	12,000	23	265	

1. Flow regulation based on the following criteria:
   - summer 6 month flow = 2 x winter 6 month flow
   - flow regulation = 60% of mean annual runoff (assuming 10% chance of reservoir empty) unless otherwise indicated on Table 2.
2. Reservoir+dam details based on 1:50,000 NTS maps and air photo interpretation except for Site 2 which is based on mapping by PFRA.

ABLE 1

T SITE DATA

UME m^3	SPILLWAY TYPE	SPILLWAY LENGTH[3] m	SPILLWAY CAPACITY m^3/s	CONSTRUCTION DIVERSION TYPE[4]	CONSTRUCTION DIVERSION CAPACITY m^3/s	CONSTRUCTION DIVERSION LENGTH m	TYPE OF LOW LEVEL OUTLET	OTHER
00	hyd. jump stilling basin	147	900	Tunnel	270	200	Tunnel[4]	
200 am nd kes	-reverse flow through diversion channel -emergency spillway provided	-	-	coffer dam and conduit	3	200	Conduit	-6m high diversion weir required on Willow Creek. -Diversion channel from Willow Creek ($700,000m^3$ excavation) -side valley dykes required.
30	flip bucket	115	1000	Tunnel	190	225	Tunnel[4]	
.80	flip bucket	140	530	Tunnel	120	180	Tunnel[4]	
780	hyd. jump stilling basin	268	450	Tunnel	100	290	Tunnel[4]	
410	flip bucket	70	380	Tunnel	18	200	Tunnel[4]	

3. Length of spillway from headblock to end of flip bucket or concrete lined stilling basin.

4. Construction diversion tunnel will also serve as low level outlet.

TABLE 1

TABLE 2

PRELIMINARY COMPARISON OF POTENTIAL

SITE NO.	HYDROLOGY	DAM FOUNDATION	OTHER STRUCTURES	RATIO OF RESERVOIR VOL TO DAM VOL.	R	
					LAND	FARM
1	- provides flow regulation for about 50% of mean annual runoff. - storage capacity is 37,000 dam^3 less than that required for 60% flow regulation.	- expect pervious foundation will require seepage control measures.	- relatively high spillway capacity and construction diversion capacity.	35	- 215 ha private 60 ha crown - 70% rangeland 30% treed	1 int
2	- provides flow regulation for about 54% of mean annual runoff. - storage capacity is 22,500 dam^3 less than required for 60% flow regulation.	- soft silt and clay foundation will require shallow dam side slopes. - weir and diversion dyke on pervious floodplain and will require seepage control.	- requires gravity diversion from Willow Creek. - no spillway required.	42 Including dam & dykes	- 540 ha private - 99% rangeland 1% cultivated	1 aba 3 sma 1 int 1 lar dam)
3	- provides flow regulation for 60% of mean annual runoff.	- stable rock abutments and expect rock foundation. - rock will require grouting.	- good spillway site on rock foundation. - relatively long tunnel. - relatively high spillway capacity and construction diversion capacity.	123	- 260 ha private and 35 ha crown - 80% rangeland 20% treed	1 lar
4	- provides flow regulation for 60% of mean annual runoff.	- stable rock abutments and expect rock foundation. - rock will require grouting.	- spillway on rock foundation	167	- 400 ha private - 100% rangeland	2 int
5	- provides flow regulation for 60% of mean annual runoff.	- expect pervious foundation will require seepage control measures.	- spillway on rock foundation. - relatively long spillway and tunnel.	32	- 200 ha private - 70% rangeland 30% treed	1 sma
6	- storage capacity is 7,500 dam^3 less than required for 60% flow regulation	- stable rock abutments. - expected pervious foundation will require seepage control measures.	- spillway on rock foundation. - relatively short spillway.	29	- 130 ha private - 70% rangeland 30% brush	0

[1] Wildlife Key Area maps, Fish and Wildlife Division, Alberta Energy and Natural Resources, 1981

[2] Fish Resource Maps, Fish and Wildlife Division, Alberta Energy and Natural Resources, 1982

RESERVOIR SITES

RESERVOIR DAMAGES		UNIT CAPITAL COST[3] $/dam	ENVIRONMENTAL IMPACT		RANK
STEADS	ROAD/BRIDGE RELOCATION		MAP CLASSIFICATION[1] (See Table 3 for details)	FISH SPECIES[2]	
ermediate	0	790	- Wildlife Key Area for Mule Deer and White Tailed Deer.	Sucker	4
ndoned? 11 ermediate ge (D/S of	- 1 major causeway required - 6.5 km road	439	–	-	1
ge	0	424	-	Rainbow Trout Eastern Brook Trout Mountain Whitefish Sucker	1
ermediate	- 1 bridge - 6.5 km road	543	–	Rainbow Trout Eastern Brook Trout Mountain Whitefish Sucker	3
11	- 1.6 miles road	1038	- Wildlife Key Area for Moose	Rainbow Trout	5
	0	725	- Wildlife Key Area for Great Blue Heron, Mule Deer and White Tailed Deer.	Cutthroat Trout Rainbow Trout Sucker Spawning area for Trout	6

TABLE 2

SITE NO.	FISH RESOURCE MAPS-SPECIES Fish and Wildlife Division, AENR, 1982	WILDLIFE KEY AREAS Fish and Wildlife Division, AENR, 1981	LAND CAPABILITY FOR WATERFOWL[1] Canada Land Inventory	LAND CAPABILITY FOR RECREATION[2] Canada Land Inventory
1	Sucker	Mule Deer White Tailed Deer	6B	5AOK
2	-	-	6T	5LQ0
3	Rainbow Trout Eastern Brook Trout Mountain White Fish Sucker	-	6TB	4VAK
4	Rainbow Trout Eastern Brook Trout Mountain Whitefish Sucker	-	6T	4VQP
5	Rainbow Trout	Moose	6T	4VAK
6	Cutthroat Trout Rainbow Trout Sucker	Mule Deer White Tailed Deer Great Blue Heron	6T	4AVQ

CLASSIFICATION NOTES:

1. Land Capability for Water Fowl
   Class: 6 Severe limitations to the production of water fowl.
   Subclass: B Fast flowing water
   T Adverse Topography

2. Land Capability for Outdoor Recreation
   Class: 4 Moderate Capability
   5 Moderately Low Capability
   Subclass: See Canada Land Inventory Legend

E 3

L LAND CLASSIFICATION

LAND CAPABILITY FOR FORESTRY[3] Canada Land Inventory	SOIL CAPABILITY FOR AGRICULTURE[4] Canada Land Inventory	PRESENT LAND USE[5] Canada Land Inventory	ECOLOGICAL LAND CLASSIFICATION AND EVALUATION LIVINGSTONE-PORCUPINE AENR
-	5 ST (80%) 6 T (20%)	U 30% K 60% Some A,P & E	Shrubs, Aspen, Willow
-	6 T (60% 5 S (40%)	mainly K some A&P	N/A
7 MC	6 T(80%) 5 ST (20%)	mainly K some T&P	Shrubs, Aspen, Willow
7 MC (70%) 5 M (30%)	5 C	mainly K some P	N/A
5 M (60%) 7 MU (40%)	5 C (80%) 6 T (10%) 6 W (10%)	mainly K some U	N/A
-	5 S (80%) 6 T (20%)	K	Aspen, Willow

3. Land Capability for Forestry
   Class: 5 Severe limitations to growth of commercial forests
   7 Severe limitations which preclude the growth of commercial forests
   Subclass: See Canada Land Inventory Legend

4. Land Capability for Agriculture
   Class: 5 Severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible
   6 Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible
   Subclass: See Canada Land Inventory Legend

5. Present Land Use
   Class: A Light Brown - Cropland
   P Dark Yellow - Improved Pasture and forage crops
   K Light Yellow - Improved Pasture and Range Land
   T Dark Green - Productive Woodland
   U Light Green - Non-Productive Woodland
   E Silver - Mines, Quarries and Gravel Pits

TABLE 3

TABLE 4

CAPITAL COST SUMMARY[1]

COST ITEM	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	SITE 6
Embankments	$10,010,000	$10,850,000	$6,050,000	$1,640,000	$ 7,100,000	$3,730,000
Spillway	10,180,000	-	9,070,000	6,340,000	10,130,000	2,670,000
Diversion Tunnel	9,980,000	-	9,070,000	5,740,000	7,980,000	2,110,000
Low Level Outlet[2]	-	1,820,000	-	-	-	-
Diversion[3]	-	6,000,000	-	-	-	-
RESERVOIR DAMANGES						
-Road Relocation	-	910,000	-	910,000	220,000	-
-Bridges	-	-	-	700,000	-	-
-Clearing	160,000	-	130,000	-	170,000	-
-Land Acquisition	350,000	850,000	400,000	670,000	300,000	200,000
-Farmsteads	140,000	630,000	280,000	280,000	70,000	-
-Causeways	-	1,120,000	-	-	-	-
TOTAL[4]	$31,000,000	$22,000,000	$25,000,000	$16,000,000	$26,000,000	$8,700,000

1. Costs include 40% contingency.
2. Cost of low level outlet included in Diversion Tunnel except for Site 2.
3. Diversion weir on Willow Creek and diversion channel.
4. Total cost is rounded to 2 significant figures.

APPENDIX I

TERMS OF REFERENCE

Alberta

ENVIRONMENT

Planning Division

403/329-5460

Provincial Building
200 - 5th Avenue, South
Lethbridge, Alberta, Canada
T1J 4C7

December 12, 1983

Klohn Leonoff Consultants Ltd.
#15 - 6320 - 11th Street S.E.
CALGARY, Alberta
T2H 2L7

ATTENTION: Don Petty

Dear Mr. Petty:

RE: WILLOW CREEK BASIN
INVENTORY OF STORAGE SITES

This letter is to invite your firm to submit a proposal for a preliminary planning study in the Willow Creek Basin (see attached terms of reference and study area map). The purpose of the study is to provide an inventory of potential water storage sites in the basin. Interested firms should submit a brief (say 10 page) proposal by Friday, December 23, 1983.

Please contact the undersigned or Sandy Larsen for additional information.

Yours truly,

L.K. Szojka

Lorand K. Szojka, P. Eng.
Oldman River Basin Planner

SL/wlp

c.c. S. Larsen

WILLOW CREEK BASIN

STORAGE ALTERNATIVES PRELIMINARY INVESTIGATION

TERMS OF REFERENCE

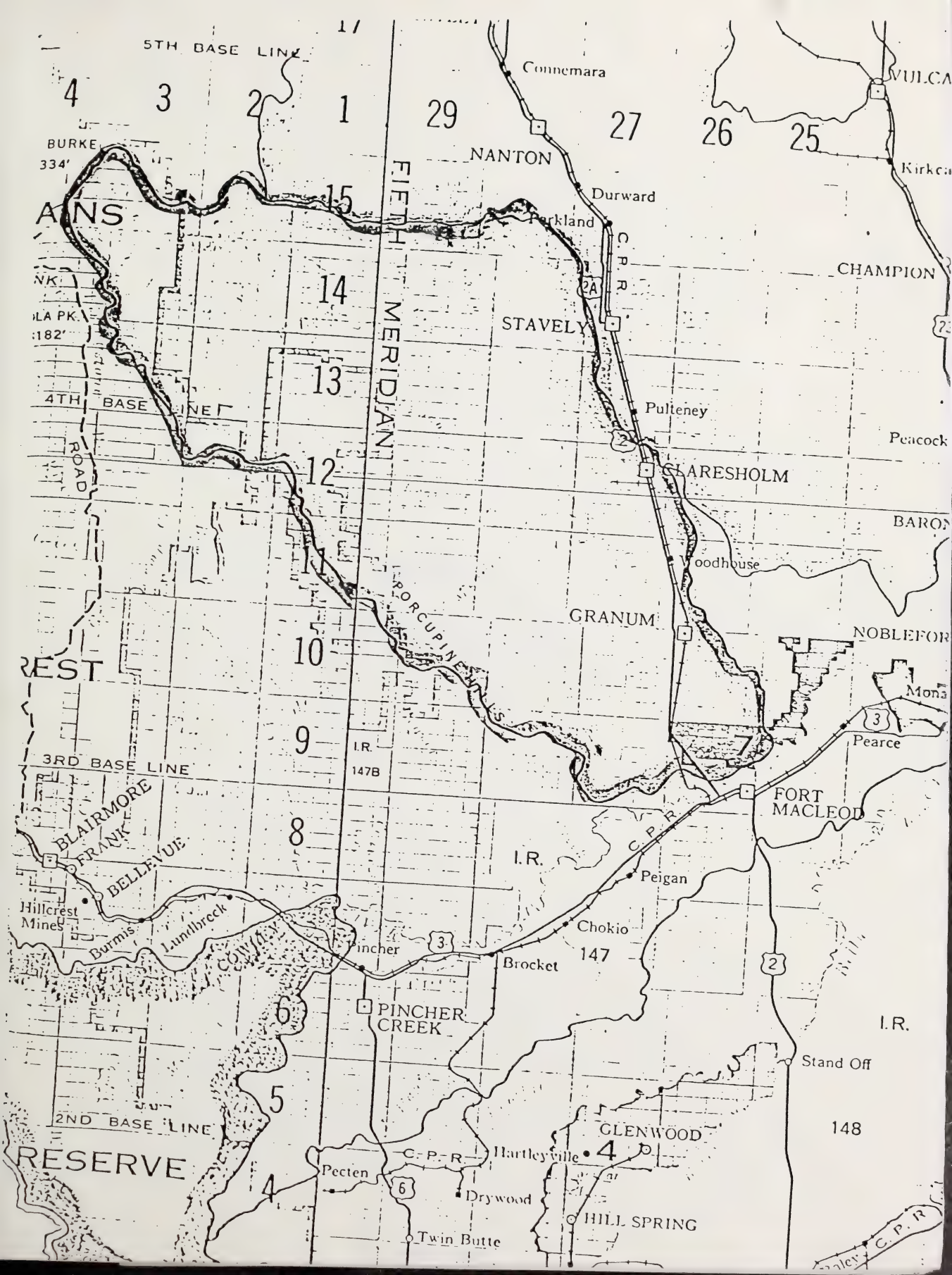
Objective: To undertake a preliminary investigation of potential onstream and offstream storage sites and to indicate the likely range of storage capabilities in the Willow Creek drainage basin.

Scope:

1) The investigation should be limited to available information and on the basis of field inspections, reports and mapping data.
2) The investigation should consider offstream sites on major tributaries to Willow Creek, as well as onstream sites.
3) For offstream storage sites various methods of water supply should be considered including natural hydrology, gravity and pumped diversion from Willow Creek.

Methodology:

1) Storage sites should be identified on the basis of the best available topographic mapping and field reconnaissance.
2) Based on available or likely water supply, and selected location, the maximum dam height and storage should be indicated for optimum storage.
3) For each damsite located, a preliminary design and cost estimate should be provided.
4) Advantages and disadvantages should be discussed for each location considering such factors as: water supply, capital and annual costs, operational aspects, suitability for municipal and streamflow augmentation, environmental features and land damages.
5) A summary comparison table of all pertinent technical features should be provided.
6) The selection of or ranking of sites should be done in consultation with the basin planner.


5TH BASE LINE
4
3
2
1
29
27
26
25
BURKE
334'
NANTON
Connemara
Durward
Parkland
FIFTH MERIDIAN
15
14
13
12
11
10
9
8
6
5
4
2A
STAVELY
CHAMPION
Pulteney
Peacock
CLARESHOLM
4TH BASE LINE
ROAD
Woodhouse
GRANUM
PORCUPINE HILLS
I.R. 147B
3RD BASE LINE
BLAIRMORE
FRANK
BELLEVUE
Hillcrest Mines
Burmis
Lundbreck
COUTTS
Pincher
Brocket
147
Peigan
Chokio
I.R.
C.P.R.
FORT MACLEOD
Pearce
NOBLEFORD
PINCHER CREEK
2ND BASE LINE
RESERVE
Pecten
C.P.R.
Hartleyville
GLENWOOD
Drywood
HILL SPRING
Twin Butte
Stand Off
148
I.R.

APPENDIX II

LIST OF REFERENCES AND MAPS

APPENDIX II

LIST OF REFERENCES

I AIRPHOTOS

1. 1:60.000 scale flown in 1981/82
   AS 2336, 2337, 2338 and 2342
2. 1:20,000 scale flown in 1983
   AS 2337, 2339 and 2340
3. 1:10,000 scale flown in 1982
   AS 2652, 2653 and 2654

II TOPOGRAPHIC MAPPING

1. 1:250,000 NTS Maps, 82J, 82G, 82H and 82I
2. 1:50,000 NTS Maps, 82I4, 82I5, 82J1, 82J8, 82H13 and 82G16

III GEOLOGY AND HYDROGEOLOGY MAPS AND REPORTS

1. Surficial Geology - Ft. Macleod
2. Surficial Geology - Fernie
3. Hydrogeologic Map of Gleichen
4. Hydrogeologic Map of Lethbridge - Fernie
5. Hydrogeologic Map of Kananaskis Lakes
6. Surficial Geology of Rocky Mountain Foothills
7. Surficial Geology of High River
8. Surficial Geology of Kananaskis Lakes
9. Bedrock Geology - Lethbridge
10. Bedrock Geology - Langford Creek
11. Bedrock Geology - Southern Plains of Alberta
12. Terrain Inventory - Kananaskis Lakes
13. Soil Surveys of Willow Creek Provincial Park
14. Soil Survey Map - Chain Lakes
15. Soil Survey Map - Lethbridge Area NN
16. Soil Survey Map - Gleichen S
17. Bedrock Topography - Gleichen

IV ENVIRONMENTAL AND RESOURCE CLASSIFICATION MAPS

1. Canada Land Inventory
   - Land Capability for Agriculture, Environment Canada
   - Land Capability for Forestry, Environment Canada
   - Land Capability for Recreation, Environment Canada
   - Land Capability for Wildlife-Waterfowl, Environment Canada
   - Land Capability for Wildlife-Ungulates, Environment Canada
   - Land Capability for Sport Fish, Fish and Wildlife, AENR
   - Present Land Use, Environment Canada
2. Wildlife Key Area Maps, Fish and Wildlife Div., AENR, 1981
3. Fish Resource Maps, Fish and Wildlife Div., AENR, 1982
4. Composit Forest Cover Services, AENR
5. Bow-Crow Forest, AENR
6. Ecological Land Classification and Evaluation, Livingston - Porcupine, AENR
7. Land Registry Maps, Alberta Recreation, Parks and Wildlife
8. Land Ownership Maps, Alberta Municipal Affairs

V GENERAL REPORTS

1. Alberta Environment, Planning Division, "Red Deer River Basin Preliminary Planning Report on Potential Damsites Upstream from Sundry", September 1976.
2. Alberta Environment, Hydrology Branch, "South Saskatchewan River Basin - Historical Natural Flows, 1912 to 1978", prepared for South Saskatchewan River Basin Planning Program, November 1982.
3. Bennett, M.R., Alberta Environment, Standards and Approvals Division, "Water Quality Study of Willow Creek, June 16 to August 25, 1977", December 1977.
4. Crysler & Lathem Ltd., "Operations Study - Chain Lakes Reservoir", February 1979.
5. Deeprose, R.K. and Yaremko, E.K., Alberta Water Resources, Hydrology Branch, "River Regime Study - Willow Creek at Chain Lakes", April 1970.
6. Environment Canada, Water Survey of Canada, "Historical Streamflow Summary - Alberta to 1982", 1983.

7. Gray, W.D., PFRA, "Report on Proposed Chain Lakes Project", November 1961.
8. Klohn Leonoff Ltd., "Old Man River Studies - Phase II Water Supply Alternatives", May 1978.
9. Klohn Leonoff Ltd., "South Saskatchewan River Basin Planning Program - Cost Study Report", prepared for Alberta Environment, October 1983.
10. Mustapha, A.M., Hydrology Branch, "Willow Creek Below Chain Lakes Dam - Low Winter Flows", 1970.
11. Northwest Hydraulics, "An Assessment of Willow Creek Flows and Water Supply Problems", April 1982.
12. PFRA, "Oldman River Flow Regulation Preliminary Planning Studies - Water Assessment", prepared for Alberta Environment, 1975.

VI OTHER SOURCES OF INFORMATION

1. Drillhole logs by Alberta Environment for the Claresholm Water Supply Intake, 1983 (contact R.S. Brittain, Geotechncial Services, Alberta Environment).
2. P.F.R.A. (contact Messieurs W. Nemanishen and E. Caligiuri, Calgary)
   - Topographic maps and preliminary design drawings of the Willow Creek - Pine Coulee Storage Project, September 24, 1958.
   - Topographic maps and geotechnical drill hole logs, for the Willow Creek - Pine Coulee Storage Project, July 1959.
   - As-built drawings of Calgary Weir, Carseland Weir, and Chain Lakes Project.

APPENDIX III

HYDROLOGIC STUDIES

MEMORANDUM

Hydrology Studies - Willow Creek Basin Inventory of Storage Sites

PROJECT: Willow Creek Basin Inventory of Storage Sites
CLIENT: Planning Division, Alberta Environment
DATE: March 5, 1984, Revised April 18, 1984

1.0 INTRODUCTION

This memorandum presents the results of a study to determine the following preliminary hydrologic design parameters:

a) Mean annual runoff.
b) Target reservoir storage capacity.
c) Design spillway discharge capacity.
d) Design construction diversion capacity.

The purpose of this study was to derive single parameter relationships in terms of catchment area in order to facilitate rapid comparison of many different potential reservoir sites as part of the project Willow Creek Basin Inventory of Storage Sites.

2.0 SITE DESCRIPTION

The Willow Creek Basin drains into the Oldman River approximately 35 km west of Lethbridge and is located immediately west of Claresholm in southeast Alberta. Its catchment area of 2500 km^2 extends through considerable relief from the plains near Claresholm, through the Porcupine Hills, to the Livingstone Range of the Rocky Mountains. Elevations range from 970 m on the plains, to 1550 m in the foothills and 2400 m in the Rocky Mountains. The basin comprises

about 25% praire land, 65% foothills and 10% relatively steep mountain slopes.

The vegetation of the area is composed mainly of rangeland grasses. Forests cover about 30% of the area, mainly west of the Fifth Meridian.

The Willow Creek Basin is subject to dramatic climatic variation from the dry semi-arid plains on the east side of the basin, to the relatively wet high altitude climate of the eastern Rocky Mountain slopes on the west side of the basin. The mean annual precipitation varies from 400 mm to over 600 mm from east to west as shown on Figure 1. The mean annual lake evaporation on the other hand, varies relatively little across the basin. As shown on Figure 2 the mean annual lake evaporation is about 700 mm at the headwaters of Willow Creek on the west boundary and about 750 mm on the plains at the east boundary. As discussed further in Section 4, there is a great variation in mean annual runoff per unit area across the basin. The average annual yield on the west side is about eight times that on the plains.

There are a number of small reservoirs for local cattle watering in the Willow Creek Basin, however the Chain Lakes Reservoir, which was completed in 1966, provides the only water storage of any significance. This reservoir is formed by two dams across the broad U-shaped valley between the Porcupine Hills and the Livingstone Range. It's total storage is 17,300 dam^3. Recreational use presently limits the useable live storage to about 6000 dam^3 to avoid excessive reservoir fluctuation.

3.0 HYDROMETRIC DATA

The hydrologic analysis considered the streamflow records at eleven Water Survey of Canada (WSC) stream gauging stations. Nine of these are located within the Willow Creek Basin as shown on Figure 3. Details of these stations and two water level gauging stations, one at Chain Lakes and one at Mud Lake, are given in Table 1 below:

TABLE 1

INVENTORY OF HYDROMETRIC GAUGING STATIONS

Willow Creek Basin and Immediate Vicinity

Creek/Lake	Sta. No.	Type	Catch area km^2	Record Yrs.
Willow Creek-near Nolan	05AB002	Discharge	2290	57
Willow Creek-near Granum	05AB015	Discharge	2000	13
Willow Creek-near Claresholm	05AB021	Discharge	1160	39
Willow Creek-below Lane Creek	05AB039	Discharge	730	5
Willow Creek-above Chain Lakes	05AB028	Discharge	163	17
Trout Creek-near Granum	05AB005	Discharge	440	17
Meadow Creek-at Hart's Ranch	05AB006	Discharge	102	12
Meadow Creek-at mouth	05AB029	Discharge	130	17
Kyiskap-near Granum	05AB038	Discharge	191	5
Five Mile Creek-near Spring Point	05AB014	Discharge	53.1	2
Beaver Creek-near Brocket	05AB013	Discharge	256	21
Chain Lake Reservoir	05AB037	Water level	-	14
Mud Lake	05AB011	Water level	-	13

In addition to the stream gauging stations listed in Table 1, there are several other stations in the Willow Creek Basin and immediate vicinity, which were not used in the analysis. The two nearby gauging stations on the Oldman River are not applicable because of the relatively large drainage area. There are also six stations on Streeter Creek, in the Willow Creek Basin, which were not used in the analysis because of the relatively short record and because of unique groundwater effects.

In addition to the flow records reported by WSC, the Hydrology Branch of Alberta Environment has prepared a data series of reconstructed natural flows covering the period 1912 to 1978 for the following three gauging stations in the Willow Creek Basin:

- Willow Creek near Nolan 05AB002
- Willow Creek near Claresholm 05AB021
- Willow Creek above Chain Lakes 05AB028

This 67 year data series represents natural flows, excluding the effect of flow regulation by Chain Lakes Reservoir since 1966, and

provides a relatively long record incorporating the dry years of the 1930's. The statistical analysis and flow regulation study discussed below have incorporated these reconstructed data series.

4.0 ANNUAL RUNOFF

The surface water regime is dominated by snowmelt runoff occuring from April to July when about 77% of the total annual runoff occurs. As shown on Figure 4, the annual peak monthly runoff typically occurs in June and the minimum monthly flow typically occurs in January. As illustrated on the figure, Willow Creek is subject to extreme variation in flow.

A statistical analysis of annual flow variation was carried out on the following three long term stream gauging stations, using reconstructed natural flows.

- Willow Creek near Nolan
- Willow Creek near Claresholm
- Willow Creek above Chain Lakes

The results of this analysis are given in Table 2 below and plotted on Figure 5.

TABLE 2

FREQUENCY OF ANNUAL RUNOFF ON WILLOW CREEK

Stream Gauging Station	Annual Runoff				
	10 yr Dry dam^3	5 yr Dry dam^3	Mean dam^3	5 yr Wet dam^3	10 yr Wet dam^3
Willow Creek near Nolan	34,000	48,000	148,000	228,000	321,000
Willow Creek near Claresholm	27,000	38,000	107,700	164,000	226,000
Willow Creek above Chain Lakes	10,000	13,500	34,700	51,200	68,500

The mean annual runoff at these and other applicable stream gauging stations on Willow Creek, Trout Creek and Meadow Creek are summarized in Table 3 below.

TABLE 3

MEAN ANNUAL RUNOFF IN WILLOW CREEK BASIN

Gauging Station Location	Gauging Station No.	Catchment Area km^2	Mean Annual Runoff dam^3	mm
Willow Creek above Chain Lakes	05AB028	163	34,700	213
Willow Creek below Lane Creek	05AB039	730	83,300	114
Willow Creek near Claresholm	05AB021	1,160	107,700	93
Willow Creek near Granum	05AB015	2,000	136,000	68
Willow Creek near Nolan	05AB002	2,290	148,400	65
Trout Creek at mouth	05AB005	440	23,800	54
Meadow Creek at mouth	05AB029	130	3,900	30

There is a consistent relationship between mean annual runoff and catchment area on Willow Creek, however, there is considerable discrepancy between the mean annual runoff measured on other tributary streams and that measured on Willow Creek. The reason for the discrepancy is that the headwaters of Willow Creek (and South Willow Creek) are in the relatively steep slopes of the Rocky Mountains where annual runoff is much greater than elsewhere in the basin. The other gauged tributary creeks such as Meadow Creek and Trout Creek, drain the foothills where annual runoff per unit area is much lower. Thus it is necessary to treat creeks with headwaters in the mountains, differently from creeks with headwaters in the foothills. Annual runoff for any location on Willow Creek or South Willow Creek can be obtained directly from the curves on Figure 5. Annual runoff from other tributary creeks may be estimated by comparison with Meadow Creek or Trout Creek and adjusting for the size of catchment.

The mean annual runoff volumes were converted to equivalent depth of runoff as shown on Table 3 to identify the variation in yield per unit area across the basin. Lines of equal mean annual runoff were

determined based on the measured runoff on all the gauged tributary streams in the vicinity taking into consideration the contribution of runoff on the sub-catchments located between gauging stations on Willow Creek. The results shown on Figure 6 illustrate the great variation of catchment yield across the Willow Creek Basin.

The relatively high annual runoff contribution per unit area, at the headwaters of Willow Creek is caused by the following factors:

- relatively high precipitation
- greater relief
- lower evaporation and evapotranspiration

5.0 MAXIMUM RESERVOIR STORAGE

5.1 General

The maximum required reservoir storage for any given site may be limited by one of the following factors:

a) physical (topographic) conditions
b) catchment runoff potential and required flow regulation or water withdrawal.

The maximum reservoir storage related to the physical (topographic) conditions is not addressed in this report and would be defined by a site specific study. The maximum required reservoir storage related to catchment runoff is discussed in this section. The upper limit for reservoir storage was defined in terms of the maximum regulated flow that is likely to be feasible to develop. The purpose of the analysis was to facilitate comparison of potential reservoir sites.

5.2 Method of Analysis

Reservoir simulation of monthly inflows, releases and water losses was used for the analysis. This method was applied to five long term stream gauging stations so that results at these sites could be applied to any other location by interpolation based on catchment area. The reservoir simulation method computes the active reservoir

storage for each month of available flow records. Recorded monthly stream flow is added to storage up to assumed reservoir capacity; regulated monthly release is subtracted; and monthly evaporation losses is subtracted. This analysis is repeated for several maximum reservoir capacities. The design storage is then selected based on a failure criteria related to the probability of running out of water (reservoir empty).

The incremental mass storage equation is given below.

$$Z_{t+1} = Z_t + Q_t - E_t - D_t$$

$$\text{subject to } 0 \leq Z_{t+1} \leq C$$

where Z_{t+1} = storage at end of the month t
(= storage at beginning of month t+1)
Z_t = storage at beginning of month t
Q_t = inflow during month t
D_t = release during month t
E_t = net evaporation loss from reservoir during month t
C = maximum live storage capacity

The procedure was applied to historic and reconstructed flow records of five stream gauging stations. For this preliminary analysis, net evaporation was estimated using a basin wide average net evaporation rate. Reservoir area was estimated by a formula relating reservoir area to reservoir storage. This relationship was derived by analysis of reservoir capacity and area curves of five other reservoir sites in Southern Alberta.

5.3 Criteria

The criteria for this analysis were selected following a review of existing reservoir operation in southern Alberta and previous reservoir studies by others. A brief review of the available information is itemized below:

a) The existing Chain Lakes Reservoir appears to have been designed to provide regulation of 52% of mean annual runoff from its 198 km^2 catchment.

b) The criteria for fish habitat developed by Underwood McLellan Associates for the Oldman River Studies is as follows:

Level	Flows Expressed as a Percentage of Mean Annual		
	Oct-Mar	Apr-Sept	Mean
Desirable	40%	60%	50%
Min. Desirable	20%	40%	30%
Hardship	10%	10%	10%

Considering the "minimum desirable" flow regulation (30% of mean annual runoff), the UMA criteria requires that summer flows exceed winter flows by a factor of 2.

c) The minimum allowable release rate at Dixon Dam is 16.1 m^3/s. This amounts to flow regulation of 70% of mean annual runoff.

d) The water balance study by Acres Consulting Services, carried out for the Oldman River Basin Studies, incorporated the following failure criteria:

a) A water shortage of 10% should not be experienced on an average of more than 1 in 10 years.
b) A water shortage of 20% should not be experienced on an average of more than 1 in 40 years.

The required reservoir capacity is particularly sensitive to the regulated flow rate. For 100% flow regulation the reservoirs would have to be sized to store the maximum possible runoff which could ever occur. That would be more than 3.5 times the required storage for 60% regulation.

Table 4 shows the regulated flow rates which could be obtained at three hypothetical reservoirs on Willow Creek, considering several different flow regulation percentages.

TABLE 4
MEAN ANNUAL REGULATED FLOW RATES
FOR SEVERAL FLOW REGULATION CRITERIA

Percent Regulation Mean Annual Runoff	Willow Creek Above Chain Lakes. Catchment area is 163 km^2 m^3/s	Willow Creek Near Claresholm. Catchment area is 1160 km^2 m^3/s
40	0.43	1.36
60	0.65	2.03
80	0.86	2.71
100	1.08	3.39

The sensitivity of reservoir storage capacity relative to flow regulation requirements is illustrated on Figure 7. As indicated, for flow regulation greater than 60% of the mean annual runoff, very large increases in storage capacity are required. A reservoir located at Willow Creek near Claresholm would have to be 140% larger to enable 80% flow regulation as compared to 60% flow regulation. Thus, it is assumed to be impractical to develop regulated flow greater than 60% of the mean annual flow.

Considering the factors discussed above, the following criteria were selected to determine the maximum required reservoir storage capacity:

a) Regulated release equals 60% of mean annual runoff
b) Flows in April to September should be double the flows from October to March
c) The reservoir may empty only once every ten years

5.4 Results of the Analysis

The results of the analysis are given in Table 5 below.

TABLE 5

MAXIMUM REQUIRED RESERVOIR CAPACITY

Creek/Location*	Catchment Area km^2	Reservoir Capacity dam^3
Willow Creek near Nolan	2290	113,000
Willow Creek near Claresholm	1160	77,000
Willow Creek above Chain Lakes	163	19,900
Trout Creek at mouth	440	17,000
Meadow Creek at mouth	130	3,200

* located at site of WSC stream gauging station

These results are plotted on Figure 8 to indicate the relationship of maximum required reservoir storage to catchment area. The results can be applied to any other site as follows:

a) For sites on Willow Creek, maximum required storage can be obtained from the curve on Figure 8 which enables interpolation between the analysed locations.

b) For other creeks with headwaters not in the mountains, maximum required storage can be roughly estimated by selecting a new curve below that for Willow Creek based on the characteristics of the selected catchment relative to that of Trout Creek, or Meadow Creek.

A sample computer printout of reservoir simulation for a site on Willow Creek near Claresholm, using the reconstructed flows from 1912

to 1978 is attached. Two simulations are included, one for a 60,000 dam^3 reservoir and one for an 80,000 dam^3 reservoir.

6.0 PRELIMINARY DESIGN CAPACITY OF SPILLWAYS

The Dam Safety Branch of Alberta Environment has specified the required design flood criteria in terms of reservoir size and relative damages in the event of failure. The type of reservoirs to be considered in the Willow Creek Basin will be larger than 1000 dam^3 and the damage hazard (as defined by the Dam Safety Branch) is expected to be "significant". The associated design criteria for this type of reservoir are as follows:

Reservoir Capacity	Design Flood
1000 to 50,000 dam^3	0.5 PMF*
$>$ 50,000 dam^3	0.75 PMF*

*Probable Maximum Flood

An approximate relationship between design spillway discharge and catchment area, was required in order to facilitate rapid comparison and screening of many different potential reservoir sites on the Willow Creek Basin. Envelope curves relating the PMF mean daily peak discharge to catchment area were developed by the Saskatchewan Nelson Basin Board (SNBB) as shown on Figure 9. The SNBB developed two curves, one for mountain-fed streams and one for prairie-fed streams. A third one for creeks in the foothills, was added to Figure 9 being the mean between that for mountain streams and prairie streams. For purposes of this report, Willow Creek and South Willow Creek are considered to be mountain-fed creeks and Trout Creek, Meadow Creek and Kyiskap Creek are considered to be creeks in the foothills.

For this preliminary stage of analysis it was assumed that the PMF mean daily peak discharge would represent the design spillway capacity. This does not take into consideration the much higher peak

instantaneous PMF discharge and does not allow for the routing effect of the reservoir. Since these are compensating factors it is reasonable to assume that this method will provide adequate spillway discharge estimates for the purposes of this preliminary study.

Thus the preliminary spillway design discharge is estimated as follows:

a) determine catchment area of reservoir
b) select the PMF mean daily discharge using the appropriate curve on Figure 9
c) compute the design spillway discharge by multiplying the mean daily discharge by the catchment area and by 0.5 or 0.75 depending on the size of reservoir

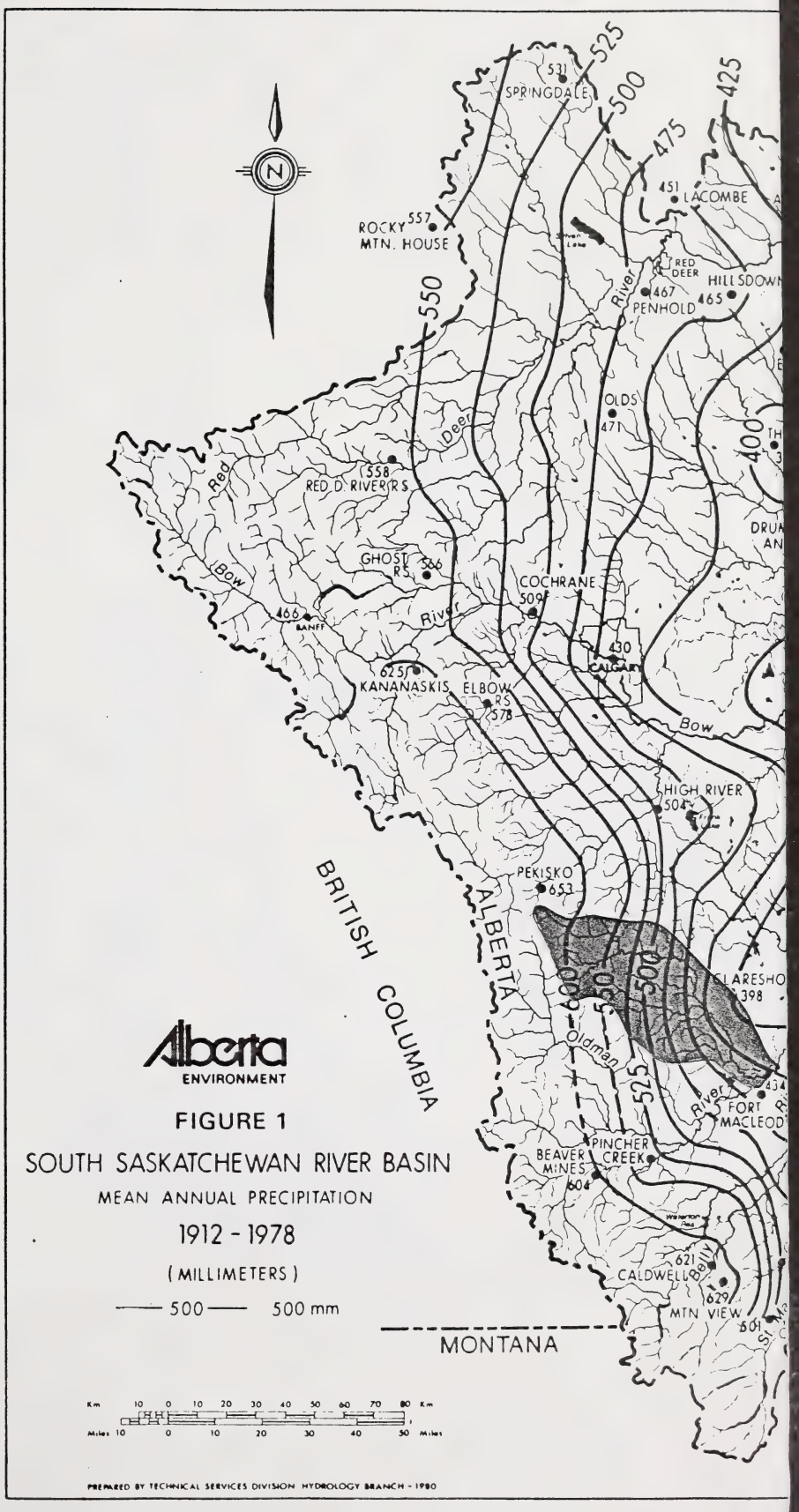
7.0 PRELIMINARY DESIGN CAPACITY OF CONSTRUCTION DIVERSION TUNNELS

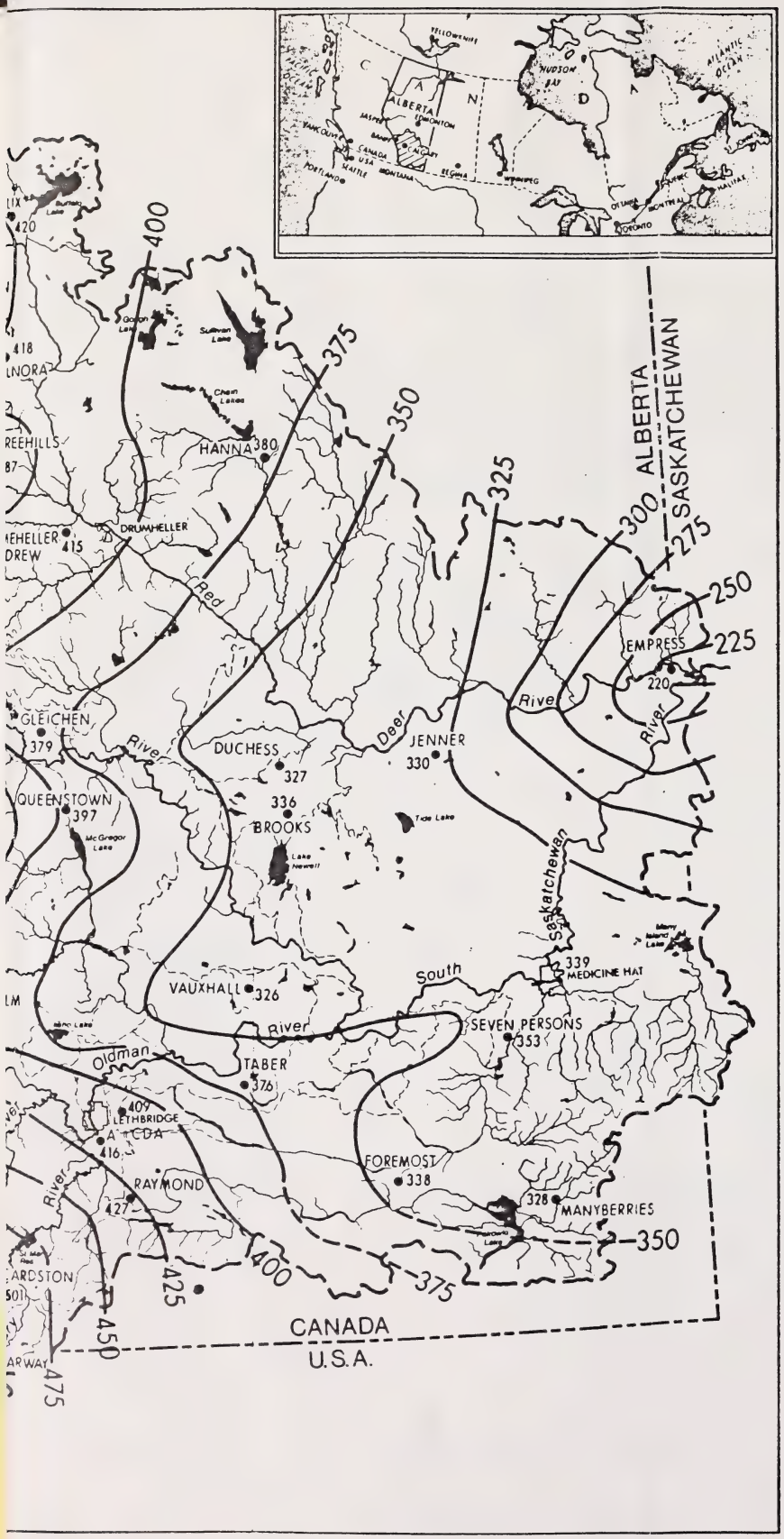
An analysis of design floods during construction was necessary for preliminary sizing and costing of the diversion systems during construction. It was assumed that the construction diversions should be capable of handling the 25 year flood peak.

Flood frequency analyses, using the Modified Gumbel method, were performed on the annual peak instantaneous discharges measured at the following WSC stream gauging stations.

- Willow Creek near Nolan
- Willow Creek near Claresholm
- Willow Creek above Chain Lakes
- Trout Creek near mouth

The 25 year peak discharges per unit area are plotted on Figure 10 for each of these stations, relative to catchment area to enable interpolation for other locations.

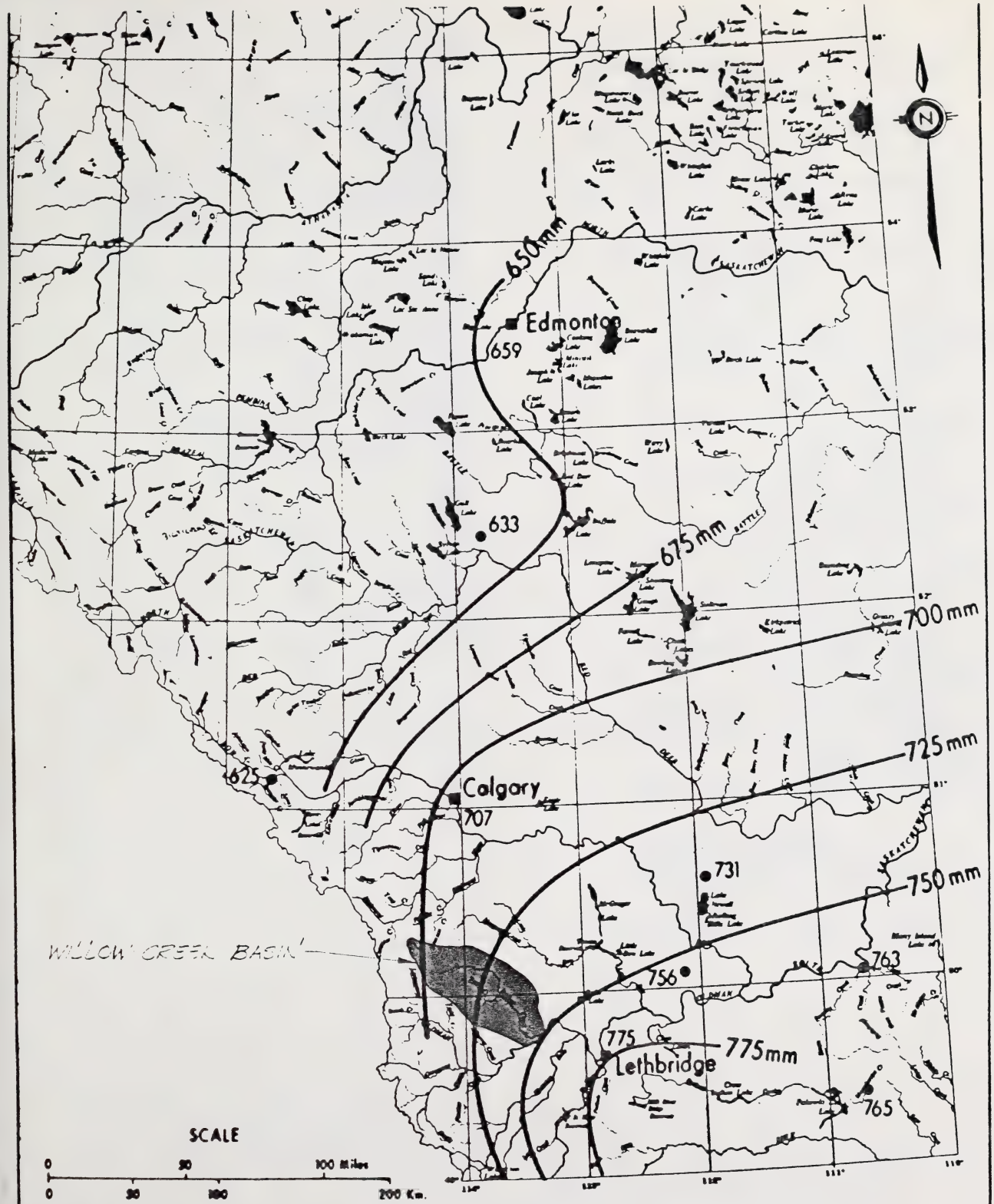

N
SPRINGDALE
531
525
500
475
425
ROCKY MTN. HOUSE
557
LACOMBE
451
RED DEER
HILLSDOWN
PENHOLD
467
465
River
550
OLDS
471
Deer
Red
RED D. RIVER RS
558
400
GHOST R.S.
556
COCHRANE
509
Bow
River
BANFF
466
430
CALGARY
KANANASKIS
625
ELBOW R.S.
578
Bow
HIGH RIVER
504
PEKISKO
653
BRITISH COLUMBIA
ALBERTA
500
505
Oldman
River
525
FORT MACLEOD
PINCHER CREEK
BEAVER MINES
604
621
CALDWELL BELLY
629
MTN VIEW
MONTANA
Alberta
ENVIRONMENT
FIGURE 1
SOUTH SASKATCHEWAN RIVER BASIN
MEAN ANNUAL PRECIPITATION
1912 - 1978
(MILLIMETERS)
500 500 mm
Km 10 0 10 20 30 40 50 60 70 80 Km
Miles 10 0 10 20 30 40 50 Miles
PREPARED BY TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH - 1980



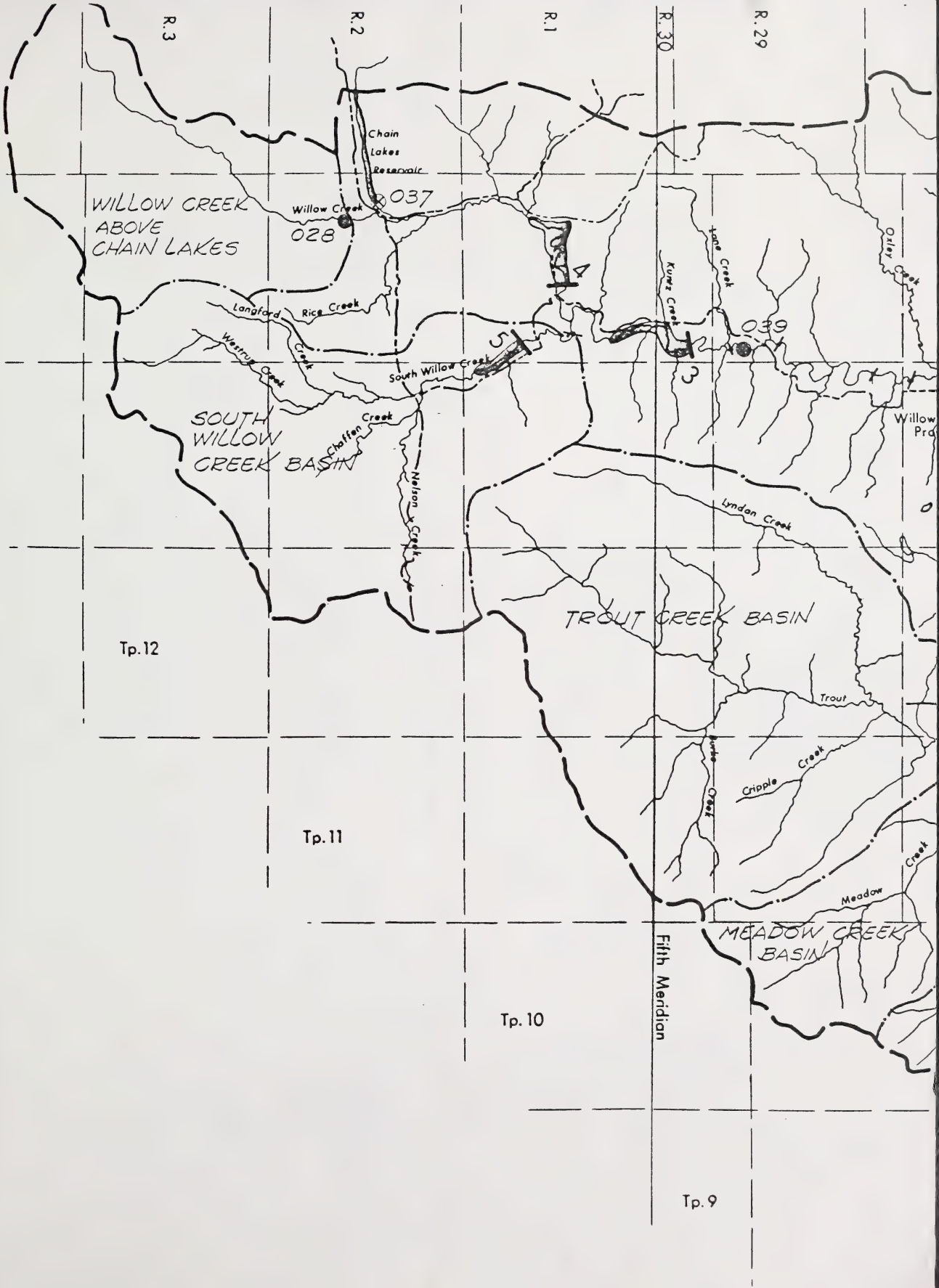
WILLOW CREEK BASIN

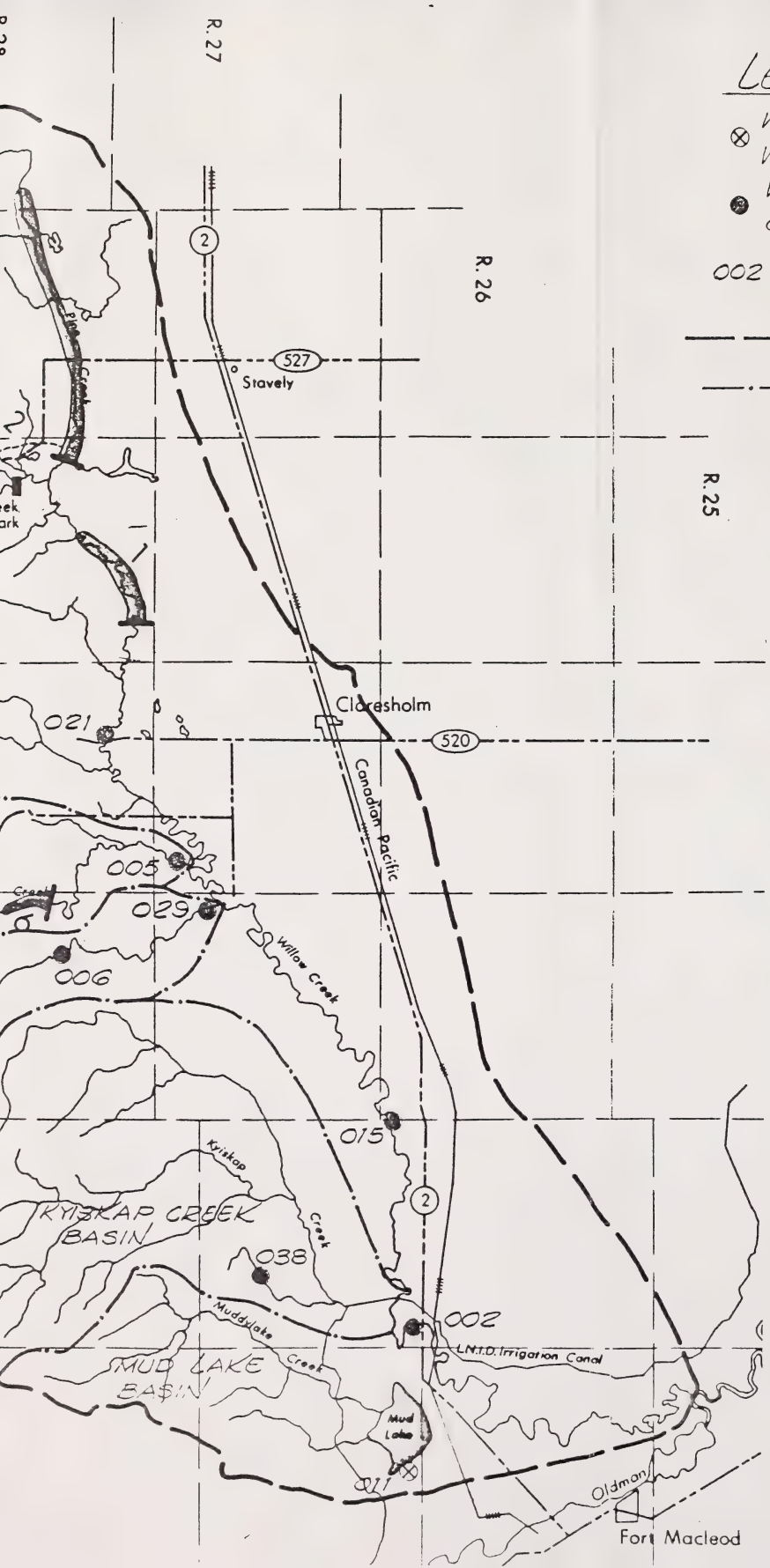
MEAN ANNUAL PRECIPITATION WILLOW CREEK BASIN

FIGURE 1



Alberta ENVIRONMENT	TECHNICAL SERVICES DIVISION HYDROLOGY BRANCH	MEAN ANNUAL GROSS EVAPORATION FROM LAKES AND RESERVOIRS
SUBMITTED R. BOTHE, P. ENG. DATE FEB. 1981	DESIGNED R. BOTHE, P. ENG. CHECKED R. BOTHE, P. ENG.	
APPROVED J. CARD, P. ENG. DATE FEB 1981	DRAWN V. DA SILVA CHECKED R. BOTHE, P. ENG.	SCALE AS SHOWN DATE FEB 1981 — FIGURE No. 2


R. 3
R. 2
R. 1
R. 30
R. 29
Chain Lakes Reservoir
037
WILLOW CREEK ABOVE CHAIN LAKES
Willow Creek
028
Langford
Rice Creek
Westrup Creek
South Willow Creek
SOUTH WILLOW CREEK BASIN
Chalfen Creek
Nelson Creek
Kunz Creek
Lone Creek
039
Otey Creek
Willow Pra
Lyndan Creek
TROUT CREEK BASIN
Trout
Cripple Creek
Meadow
Creek
MEADOW CREEK BASIN
Tp. 12
Tp. 11
Tp. 10
Tp. 9
Fifth Meridian



LEGEND

- ⊗ WATER SURVEY OF CANADA (WSC) WATER LEVEL GAUGE
- ● WSC STREAM GAUGING STATION
- 002 STATION NUMBER WITHOUT PREFIX (05AB)
- — — BOUNDARY OF WILLOW CREEK BASIN
- —·— BOUNDARY OF SUB-BASIN

STREAM GAUGING STATIONS

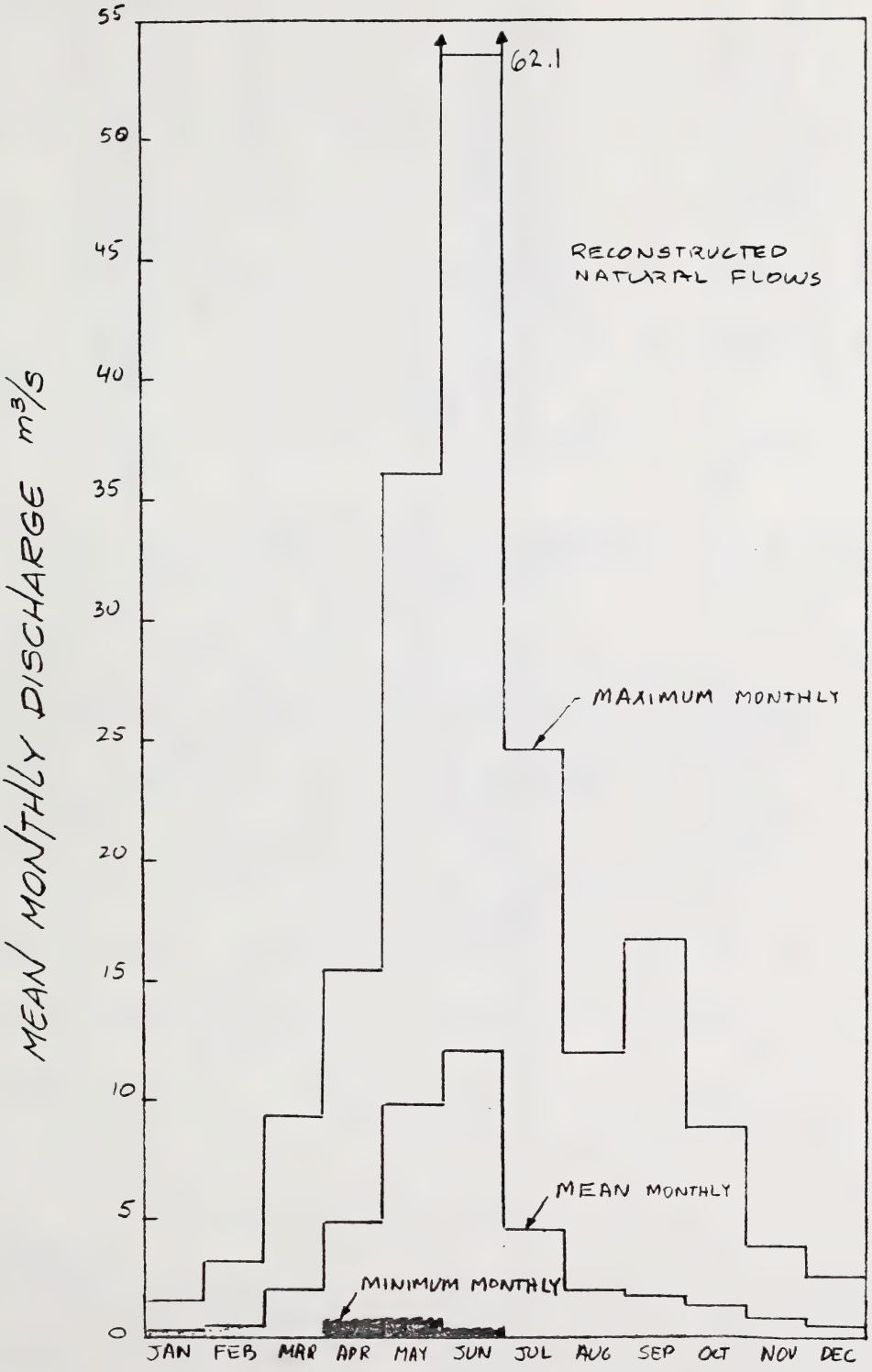
05AB 002 - WILLOW CREEK NEAR NOLAN
05AB 015 - WILLOW CREEK NEAR GRANUM
05AB 021 - WILLOW CREEK NEAR CLARESHOLM
05AB 026 - WILLOW CREEK ABOVE CHAIN LAKES
05AB 029 - MEADOW CREEK AT MOUTH
05AB 039 - WILLOW CREEK BELOW LANE CREEK
05AB 005 - TROUT CREEK
05AB 006 - MEADOW CREEK AT HARTS RANCH
05AB 038 - KYISKAP CREEK

WATER LEVEL GAUGING STATIONS

05AB 037 - CHAIN LAKES RES.
05AB 011 - MUD LAKE

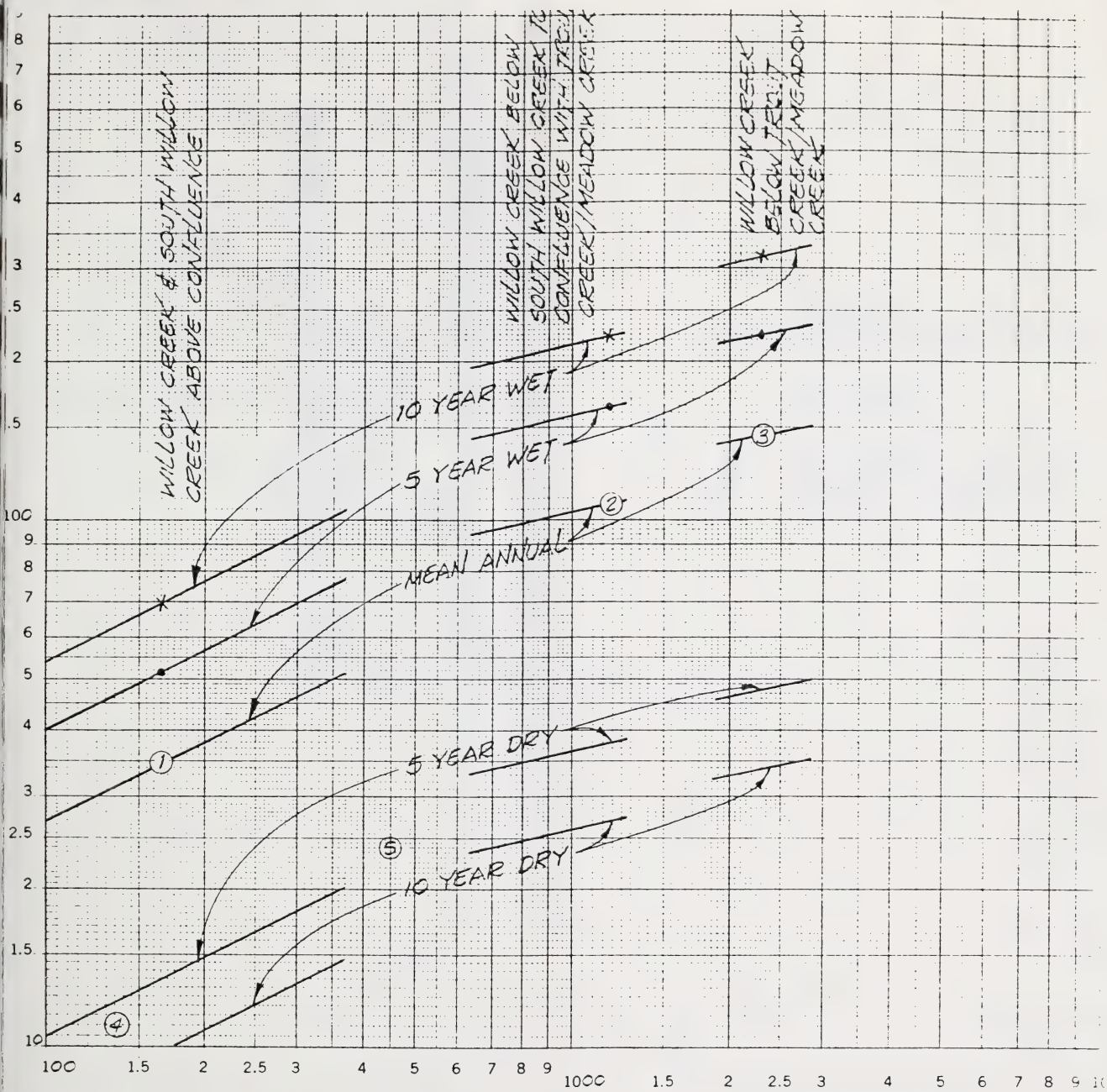
LOCATION PLAN - HYDROMETRIC STATIONS

FIGURE 3



ANNUAL FLOW VARIATION
WILLOW CREEK NEAR CLARESHOLM

FIGURE 4



LEGEND

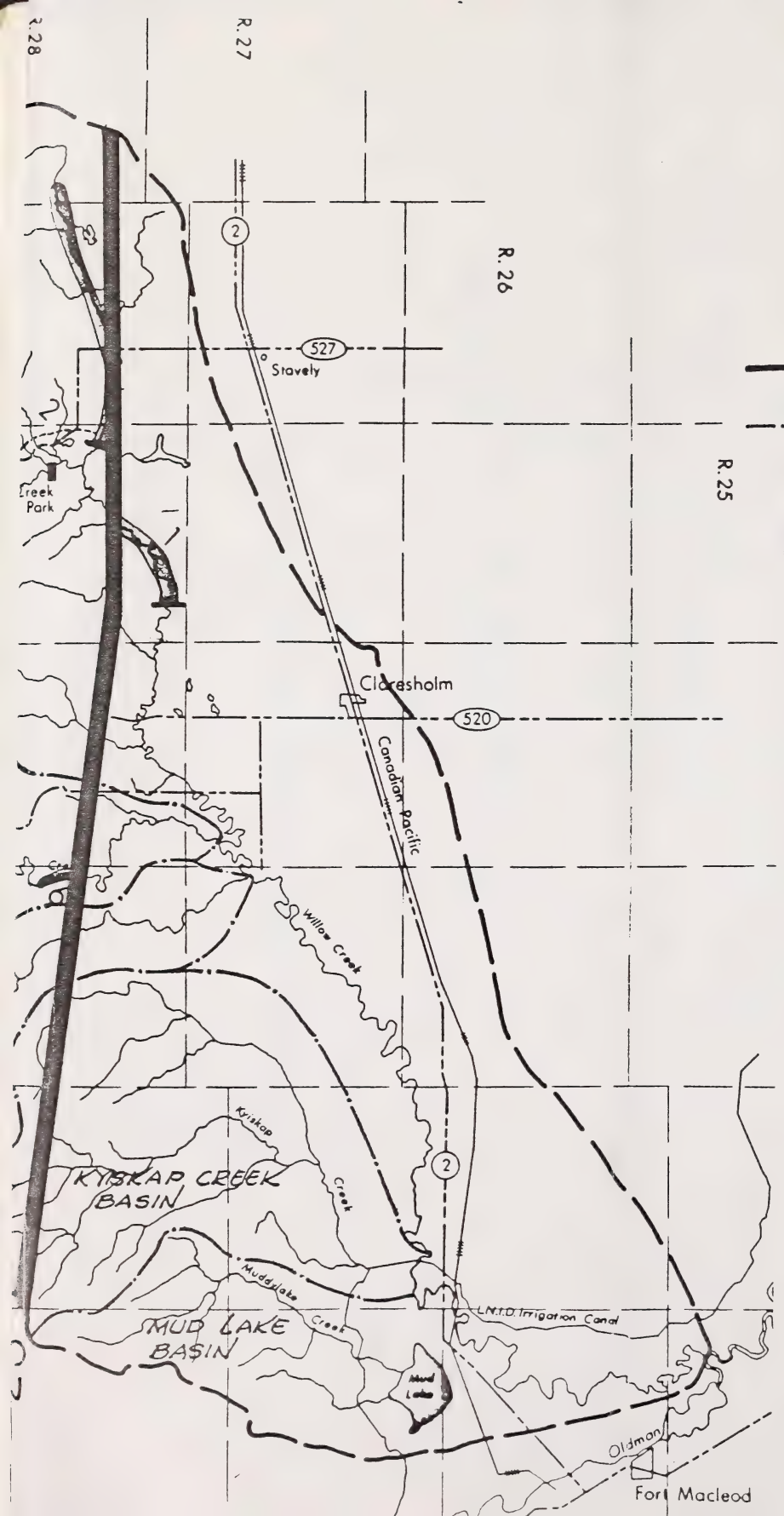
× RUNOFF 10 YR. WET YEAR
• RUNOFF 5 YR. WET YEAR
② WSC STREAM GAUGING STATION

① WILLOW CREEK ABOVE CHAIN LAKES
② WILLOW CREEK NEAR CLARESHOLM
③ WILLOW CREEK NEAR NOLAN
④ MEADOW CREEK NEAR MOUTH
⑤ TRIB. CREEK NEAR MOUTH

ANNUAL RUNOFF VOLUME
WILLOW CREEK

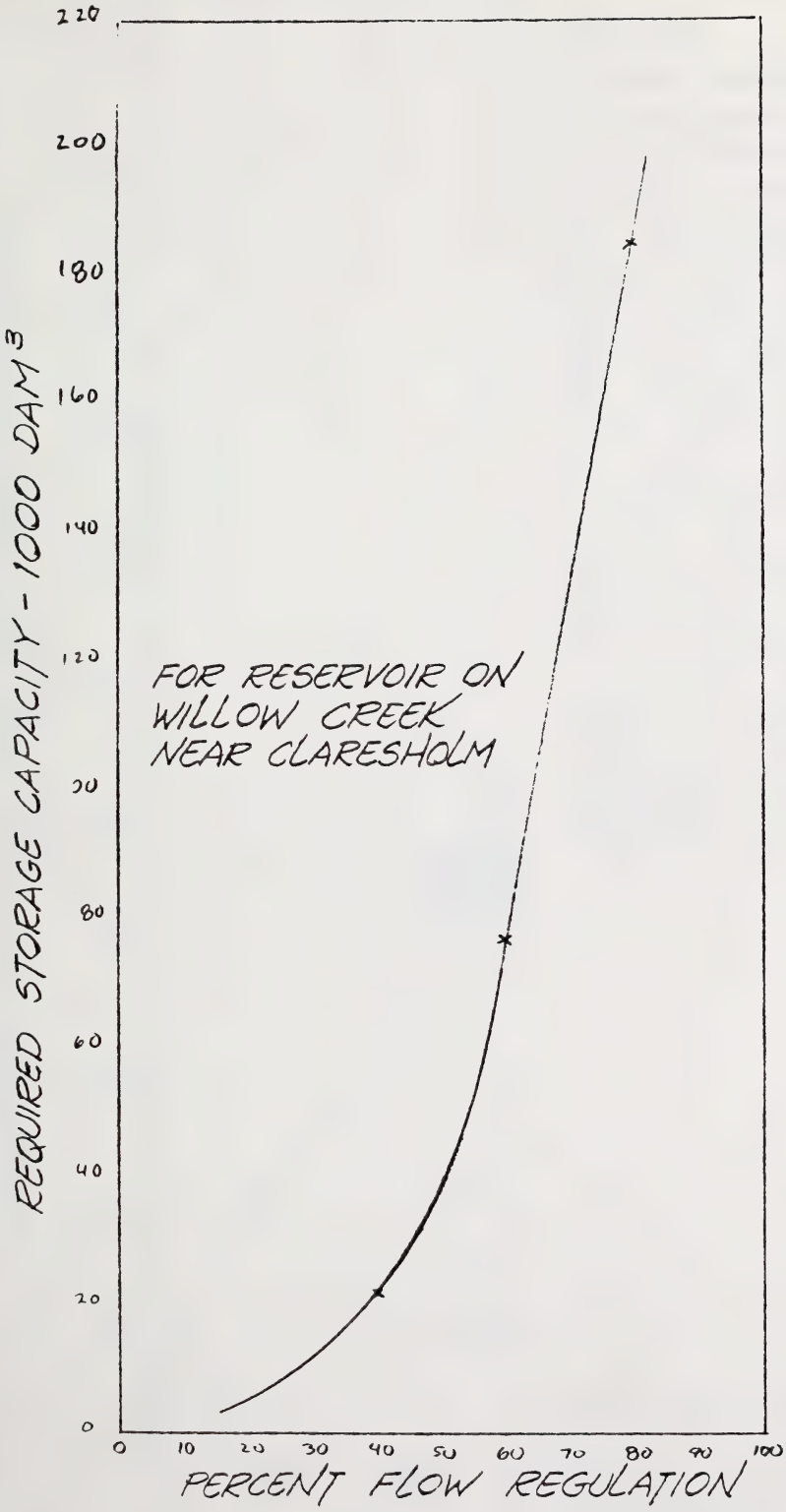
FIG. 5


R.3
R.2
R.1
R.30
R.29
Chain Lakes Reservoir
WILLOW CREEK ABOVE CHAIN LAKES
Willow Cr
Langford
Rice Cr
Westrup Creek
South Willow Creek
Chaffee Creek
Nelson Creek
SOUTH WILLOW CREEK BASIN
200
150
100
50
TROUT CREEK BASIN
Kurtz Creek
Oxley Creek
Trout
Cripple Creek
Meadow
MEADOW CREEK BASIN
Fifth Meridian
Tp. 12
Tp. 11
Tp. 10
Tp. 9



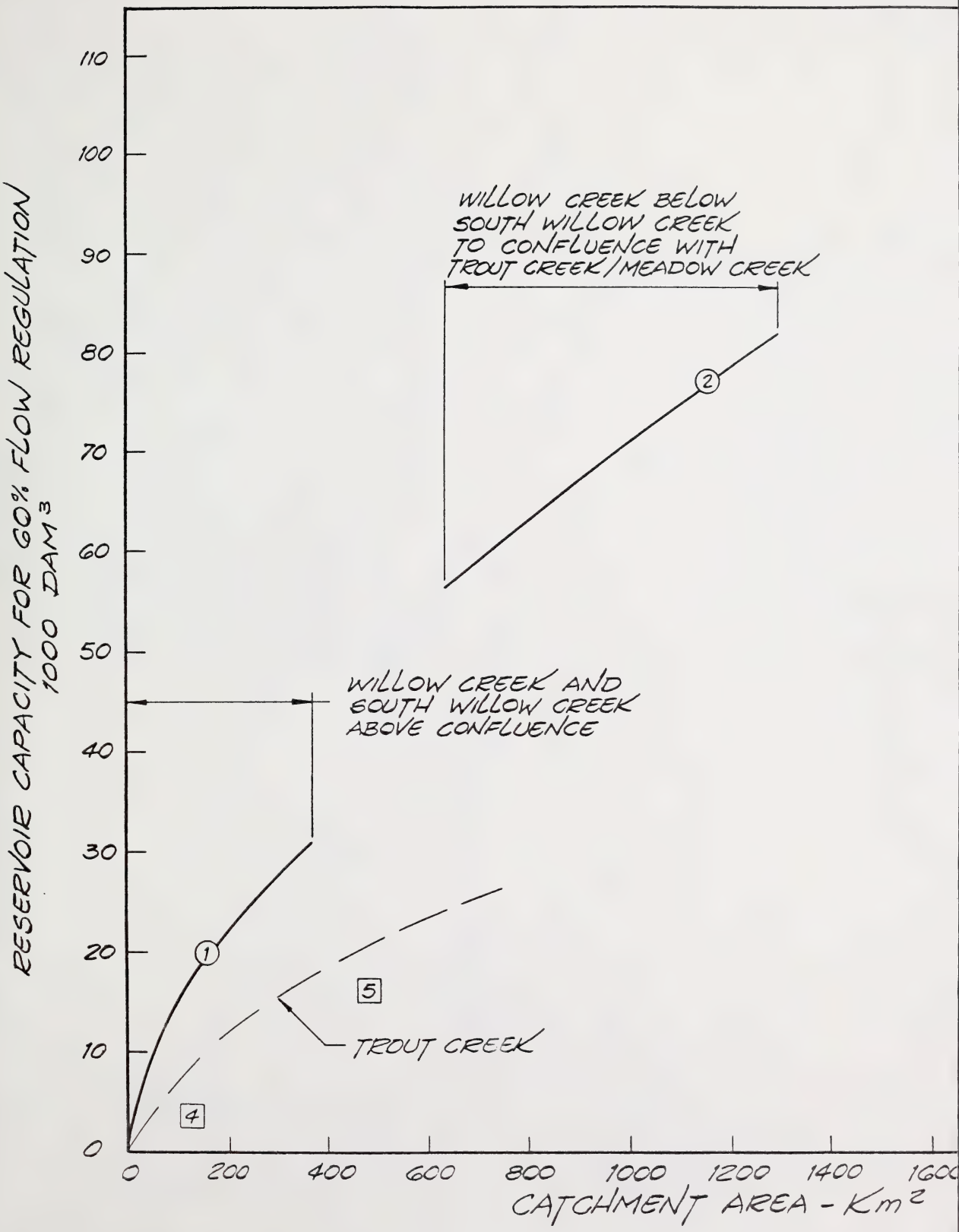
APPROXIMATE VARIATION IN MEAN ANNUAL RUNOFF

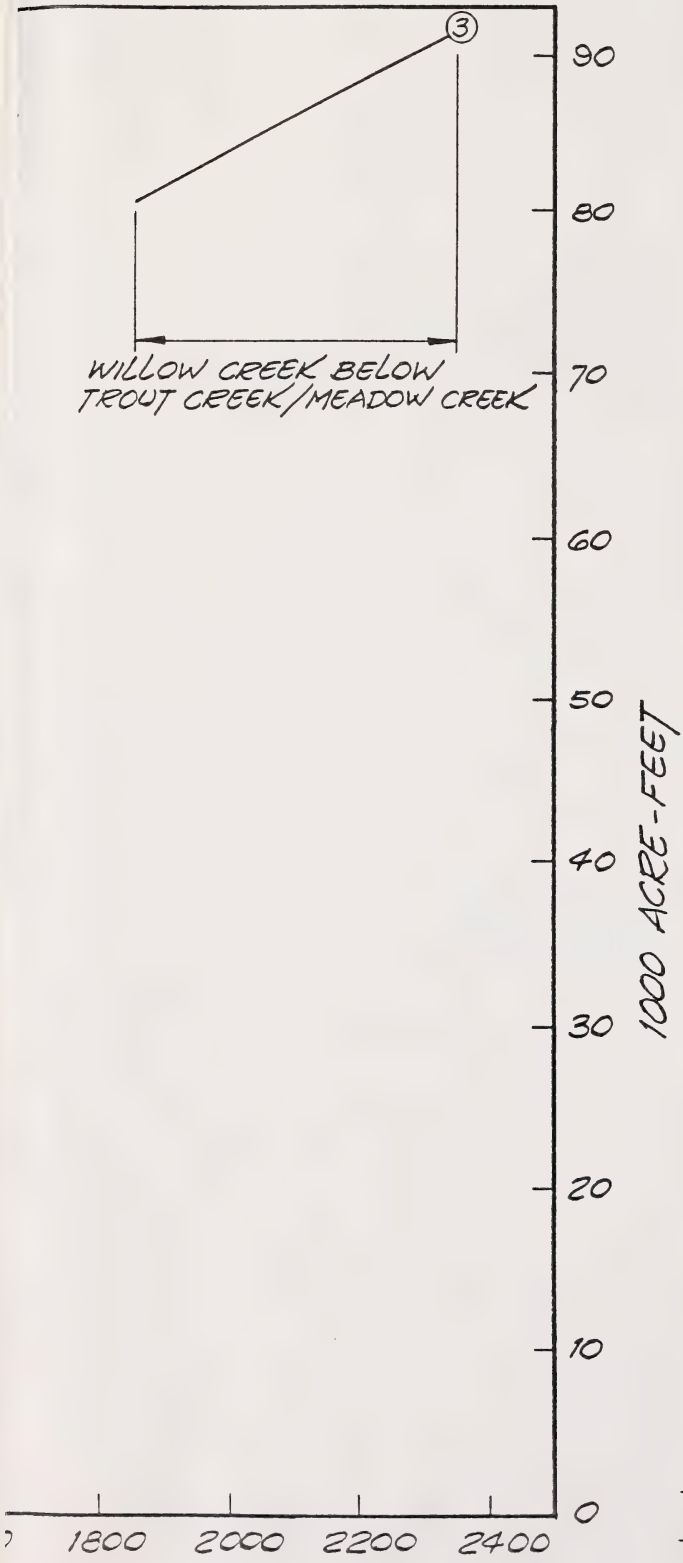
FIGURE 6



MAXIMUM STORAGE RELATED TO PERCENT FLOW REGULATION

FIGURE 7


RESERVOIR CAPACITY FOR 60% FLOW REGULATION
1000 DAM³
110
100
90
80
70
60
50
40
30
20
10
0
0
200
400
600
800
1000
1200
1400
1600
CATCHMENT AREA - Km²
WILLOW CREEK BELOW SOUTH WILLOW CREEK TO CONFLUENCE WITH TROUT CREEK/MEADOW CREEK
2
WILLOW CREEK AND SOUTH WILLOW CREEK ABOVE CONFLUENCE
1
5
TROUT CREEK
4



NOTES

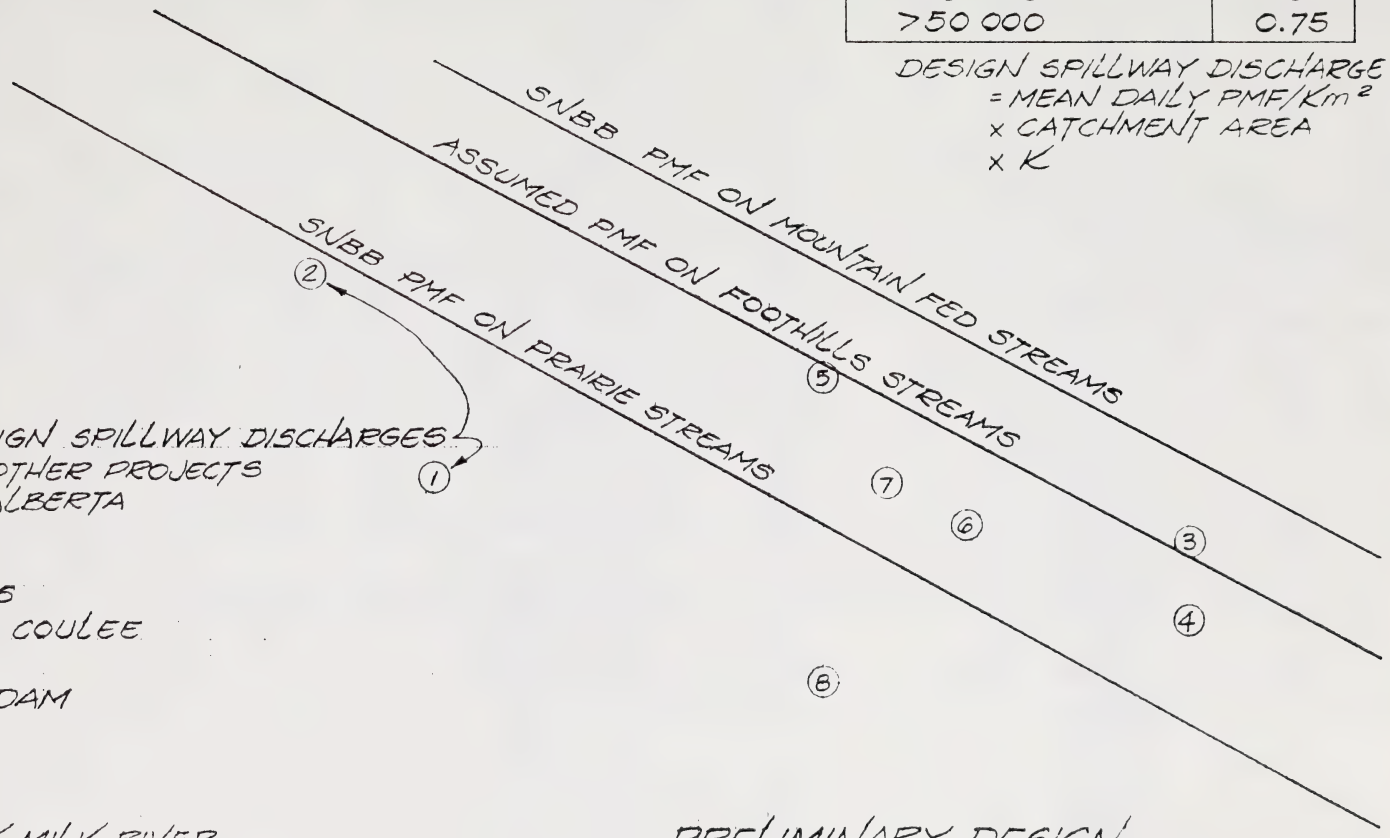
1. MAXIMUM RESERVOIR CAPACITY BASED ON 60% REGULATION OF MEAN ANNUAL RUNOFF, ALLOWING 10% CHANCE OF RESERVOIR EMPTYING.
2. THE STORAGE CURVE FOR TROUT CREEK WAS ADJUSTED BY +30% TO ACCOUNT FOR THE SHORT PERIOD OF THE RECORD.
3. THE RESERVOIR STORAGE FOR SITES ①, ② AND ③ ARE BASED ON A 67 YEAR PERIOD OF RECONSTRUCTED NATURAL FLOWS.
4. CURVES ARE BASED ON MASS STORAGE ANALYSIS OF STREAMFLOW AT THE FOLLOWING WSC STREAM GAUGING STATIONS
   - ① WILLOW CR. ABOVE CHAIN LAKES
   - ② WILLOW CR. NEAR CLARESHOLM
   - ③ WILLOW CR. NEAR NOLAN
   - ④ MEADOW CR. AT MOUTH
   - ⑤ TROUT CR. AT MOUTH

MAXIMUM RESERVOIR CAPACITY VS. CATCHMENT AREA

FIGURE 8

RESERVOIR STORAGE CAPACITY - DAM^3	K
< 50 000	0.5
> 50 000	0.75

DESIGN SPILLWAY DISCHARGE
= MEAN DAILY PMF/Km^2
× CATCHMENT AREA
× K

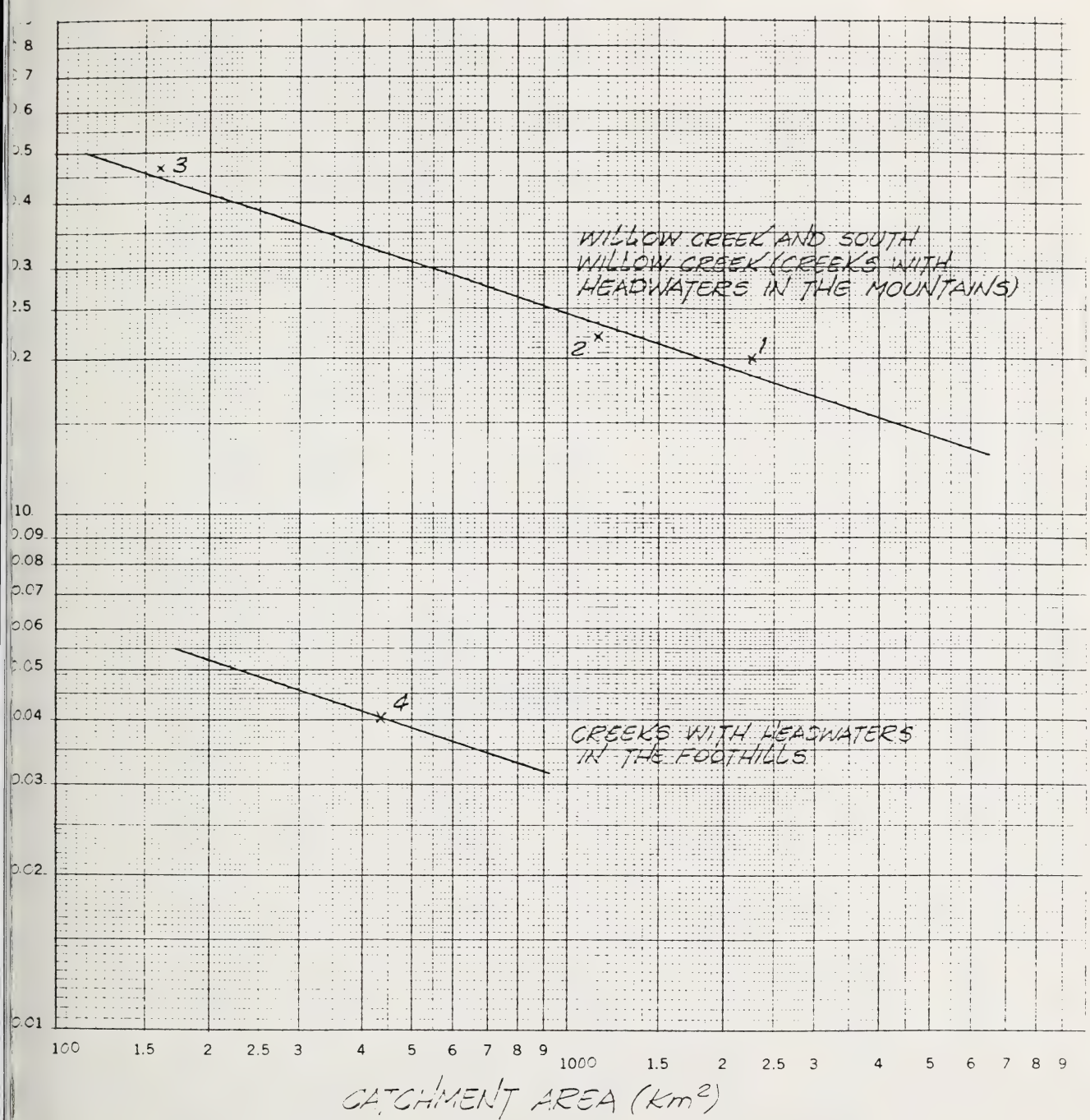


LEGEND
1. CHAIN LAKES
2. FORTY MILE COULEE
3. DIXON DAM
4. BROCKET DAM
5. SITE 5-1A
6. SITE 1-4
7. GAP
8. SOUTH FORK MILK RIVER
9. DALEMEAD

PRELIMINARY DESIGN
SPILLWAY DISCHARGE

CATCHMENT AREA - Km^2

FIGURE 9



LEGEND

1. WILLOW CREEK NEAR NOLAN
2. WILLOW CREEK NEAR MARESHOLM
3. WILLOW CREEK ABOVE CHAIN LAKES
4. TROUT CREEK NEAR MOUTH

DESIGN CAPACITY
CONSTRUCTION DIVERSION TUNNELS

FIGURE 10

DRAWINGS

ESERVOIR CAPACITY = 60000. DAM**3

YEAR	MONTH	RES. CAP. DAM**3	STORAGE DAM**3	INFLOW DAM**3	DEMAND DAM**3	EVAP DAM**3	SPILL DAM**3	DEFICIT DAM**3
1912	1	60000.	56832.	454.	3580.	43.	0.	0.
1912	2	60000.	53806.	596.	3580.	41.	0.	0.
1912	3	60000.	57289.	7103.	3580.	40.	0.	0.
1912	4	60000.	60000.	10646.	7166.	85.	684.	0.
1912	5	60000.	60000.	19506.	7166.	221.	12119.	0.
1912	6	60000.	60000.	22186.	7166.	275.	14745.	0.
1912	7	60000.	60000.	24717.	7166.	357.	17194.	0.
1912	8	60000.	60000.	16007.	7166.	275.	8566.	0.
1912	9	60000.	59960.	7237.	7166.	110.	0.	0.
1912	10	60000.	60000.	5725.	3580.	110.	1996.	0.
1912	11	60000.	59489.	3112.	3580.	43.	0.	0.
1912	12	60000.	57694.	1824.	3580.	39.	0.	0.
1913	1	60000.	54564.	491.	3580.	42.	0.	0.
1913	2	60000.	52158.	1214.	3580.	40.	0.	0.
1913	3	60000.	50898.	2360.	3580.	39.	0.	0.
1913	4	60000.	60000.	23377.	7166.	79.	7031.	0.
1913	5	60000.	60000.	24866.	7166.	221.	17480.	0.
1913	6	60000.	60000.	18836.	7166.	275.	11395.	0.
1913	7	60000.	60000.	15560.	7166.	357.	8037.	0.
1913	8	60000.	60000.	10274.	7166.	275.	2833.	0.
1913	9	60000.	57623.	4899.	7166.	110.	0.	0.
1913	10	60000.	58238.	4303.	3580.	108.	0.	0.
1913	11	60000.	57133.	2516.	3580.	42.	0.	0.
1913	12	60000.	54915.	1400.	3580.	38.	0.	0.
1914	1	60000.	51763.	469.	3580.	41.	0.	0.
1914	2	60000.	49149.	1005.	3580.	39.	0.	0.
1914	3	60000.	47847.	2315.	3580.	38.	0.	0.
1914	4	60000.	51028.	10423.	7166.	76.	0.	0.
1914	5	60000.	54233.	10572.	7166.	200.	0.	0.
1914	6	60000.	56412.	9604.	7166.	259.	0.	0.
1914	7	60000.	55506.	6604.	7166.	344.	0.	0.
1914	8	60000.	49656.	1578.	7166.	262.	0.	0.
1914	9	60000.	43597.	1206.	7166.	99.	0.	0.
1914	10	60000.	45815.	5889.	3580.	91.	0.	0.
1914	11	60000.	45378.	3179.	3580.	36.	0.	0.
1914	12	60000.	43641.	1876.	3580.	33.	0.	0.
1915	1	60000.	40524.	499.	3580.	35.	0.	0.
1915	2	60000.	38146.	1236.	3580.	34.	0.	0.
1915	3	60000.	37743.	3209.	3580.	33.	0.	0.
1915	4	60000.	38179.	7668.	7166.	66.	0.	0.
1915	5	60000.	60000.	57699.	7166.	169.	28543.	0.
1915	6	60000.	60000.	81895.	7166.	275.	74454.	0.
1915	7	60000.	60000.	57773.	7166.	357.	50250.	0.
1915	8	60000.	60000.	31343.	7166.	275.	23903.	0.
1915	9	60000.	60000.	14890.	7166.	110.	7614.	0.
1915	10	60000.	60000.	8338.	3580.	110.	4648.	0.
1915	11	60000.	60000.	4147.	3580.	43.	524.	0.
1915	12	60000.	59887.	3507.	3580.	39.	0.	0.
1916	1	60000.	56756.	491.	3580.	43.	0.	0.
1916	2	60000.	55562.	2427.	3580.	41.	0.	0.
1916	3	60000.	59610.	7668.	3580.	41.	0.	0.

1916	6	60000.	60000.	64995.	7166.	275.	57554.	0.
1916	7	60000.	60000.	29110.	7166.	357.	21587.	0.
1916	8	60000.	60000.	9530.	7166.	275.	2089.	0.
1916	9	60000.	60000.	12061.	7166.	110.	4785.	0.
1916	10	60000.	60000.	10423.	3580.	110.	6733.	0.
1916	11	60000.	60000.	5211.	3580.	43.	1589.	0.
1916	12	60000.	59917.	3536.	3580.	39.	0.	0.
1917	1	60000.	56875.	581.	3580.	43.	0.	0.
1917	2	60000.	54430.	1176.	3580.	41.	0.	0.
1917	3	60000.	54041.	3231.	3580.	40.	0.	0.
1917	4	60000.	60000.	22261.	7166.	82.	9054.	0.
1917	5	60000.	60000.	77056.	7166.	221.	69669.	0.
1917	6	60000.	60000.	93509.	7166.	275.	86068.	0.
1917	7	60000.	60000.	19878.	7166.	357.	12355.	0.
1917	8	60000.	60000.	8711.	7166.	275.	1270.	0.
1917	9	60000.	58040.	5316.	7166.	110.	0.	0.
1917	10	60000.	58491.	4139.	3580.	108.	0.	0.
1917	11	60000.	58048.	3179.	3580.	42.	0.	0.
1917	12	60000.	55435.	1005.	3580.	39.	0.	0.
1918	1	60000.	52313.	499.	3580.	41.	0.	0.
1918	2	60000.	49945.	1251.	3580.	39.	0.	0.
1918	3	60000.	50362.	4035.	3580.	38.	0.	0.
1918	4	60000.	49185.	6068.	7166.	79.	0.	0.
1918	5	60000.	52022.	10200.	7166.	196.	0.	0.
1918	6	60000.	52041.	7438.	7166.	253.	0.	0.
1918	7	60000.	46363.	1817.	7166.	328.	0.	0.
1918	8	60000.	40115.	1154.	7166.	236.	0.	0.
1918	9	60000.	34873.	2010.	7166.	87.	0.	0.
1918	10	60000.	33245.	2032.	3580.	80.	0.	0.
1918	11	60000.	30559.	923.	3580.	30.	0.	0.
1918	12	60000.	27265.	313.	3580.	27.	0.	0.
1919	1	60000.	24075.	417.	3580.	27.	0.	0.
1919	2	60000.	20910.	439.	3580.	25.	0.	0.
1919	3	60000.	17679.	372.	3580.	23.	0.	0.
1919	4	60000.	17194.	6723.	7166.	42.	0.	0.
1919	5	60000.	19005.	9083.	7166.	105.	0.	0.
1919	6	60000.	15035.	3335.	7166.	139.	0.	0.
1919	7	60000.	7987.	275.	7166.	158.	0.	0.
1919	8	60000.	1221.	484.	7166.	84.	0.	0.
1919	9	60000.	0.	447.	7166.	11.	0.	5509.
1919	10	60000.	0.	1109.	3580.	0.	0.	2470.
1919	11	60000.	0.	1608.	3580.	0.	0.	1972.
1919	12	60000.	0.	596.	3580.	0.	0.	2984.
1920	1	60000.	0.	447.	3580.	0.	0.	3133.
1920	2	60000.	0.	677.	3580.	0.	0.	2902.
1920	3	60000.	1356.	4936.	3580.	0.	0.	0.
1920	4	60000.	10634.	16453.	7166.	9.	0.	0.
1920	5	60000.	60000.	69462.	7166.	79.	12851.	0.
1920	6	60000.	60000.	31790.	7166.	275.	24349.	0.
1920	7	60000.	60000.	10721.	7166.	357.	3198.	0.
1920	8	60000.	54890.	2330.	7166.	275.	0.	0.
1920	9	60000.	48825.	1206.	7166.	105.	0.	0.
1920	10	60000.	46733.	1586.	3580.	98.	0.	0.
1920	11	60000.	44367.	1251.	3580.	37.	0.	0.
1920	12	60000.	41276.	521.	3580.	33.	0.	0.
1921	1	60000.	37967.	305.	3580.	34.	0.	0.
1921	2	60000.	35144.	789.	3580.	33.	0.	0.
1921	3	60000.	34347.	2814.	3580.	31.	0.	0.
1921	4	60000.	37020.	9902.	7166.	63.	0.	0.
1921	5	60000.	40558.	10870.	7166.	166.	0.	0
1921	6	60000.	40314.	7140.	7166.	218.	0.	0.
1921	7	60000.	35076.	2211.	7166.	282.	0.	0.
1921	8	60000.	28246.	536.	7166.	200.	0.	0.
1921	9	60000.	21568.	558.	7166.	71.	0.	0.

1921	12	60000.	13208.	489.	3580.	18.	0.	0.
1922	1	60000.	9871.	261.	3580.	18.	0.	0.
1922	2	60000.	6345.	68.	3580.	15.	0.	0.
1922	3	60000.	3081.	328.	3580.	11.	0.	0.
1922	4	60000.	8631.	12731.	7166.	15.	0.	0.
1922	5	60000.	25368.	23973.	7166.	70.	0.	0.
1922	6	60000.	28460.	10423.	7166.	165.	0.	0.
1922	7	60000.	25754.	4690.	7166.	230.	0.	0.
1922	8	60000.	19523.	1102.	7166.	167.	0.	0.
1922	9	60000.	12747.	447.	7166.	57.	0.	0.
1922	10	60000.	9949.	826.	3580.	44.	0.	0.
1922	11	60000.	6995.	640.	3580.	15.	0.	0.
1922	12	60000.	3575.	171.	3580.	11.	0.	0.
1923	1	60000.	293.	305.	3580.	8.	0.	0.
1923	2	60000.	0.	68.	3580.	2.	0.	3220.
1923	3	60000.	0.	767.	3580.	0.	0.	2813.
1923	4	60000.	0.	5740.	7166.	0.	0.	1426.
1923	5	60000.	1768.	8934.	7166.	0.	0.	0.
1923	6	60000.	60000.	110558.	7166.	34.	45126.	0.
1923	7	60000.	60000.	32311.	7166.	357.	24788.	0.
1923	8	60000.	60000.	15262.	7166.	275.	7821.	0.
1923	9	60000.	58561.	5837.	7166.	110.	0.	0.
1923	10	60000.	58543.	3670.	3580.	109.	0.	0.
1923	11	60000.	57154.	2233.	3580.	42.	0.	0.
1923	12	60000.	54742.	1206.	3580.	38.	0.	0.
1924	1	60000.	51576.	454.	3580.	41.	0.	0.
1924	2	60000.	48865.	908.	3580.	39.	0.	0.
1924	3	60000.	48814.	3566.	3580.	38.	0.	0.
1924	4	60000.	48770.	7199.	7166.	77.	0.	0.
1924	5	60000.	57788.	16379.	7166.	195.	0.	0.
1924	6	60000.	60000.	41096.	7166.	269.	31450.	0.
1924	7	60000.	60000.	7966.	7166.	357.	443.	0.
1924	8	60000.	60000.	13922.	7166.	275.	6481.	0.
1924	9	60000.	55099.	2375.	7166.	110.	0.	0.
1924	10	60000.	53529.	2114.	3580.	105.	0.	0.
1924	11	60000.	51390.	1482.	3580.	40.	0.	0.
1924	12	60000.	48497.	722.	3580.	36.	0.	0.
1925	1	60000.	45296.	417.	3580.	38.	0.	0.
1925	2	60000.	42313.	633.	3580.	36.	0.	0.
1925	3	60000.	45734.	7036.	3580.	35.	0.	0.
1925	4	60000.	50406.	11912.	7166.	74.	0.	0.
1925	5	60000.	59122.	16081.	7166.	199.	0.	0.
1925	6	60000.	60000.	28663.	7166.	272.	20347.	0.
1925	7	60000.	57301.	4824.	7166.	357.	0.	0.
1925	8	60000.	52526.	2658.	7166.	267.	0.	0.
1925	9	60000.	49978.	4720.	7166.	102.	0.	0.
1925	10	60000.	52106.	5807.	3580.	99.	0.	0.
1925	11	60000.	51636.	3149.	3580.	39.	0.	0.
1925	12	60000.	49874.	1854.	3580.	36.	0.	0.
1926	1	60000.	46755.	499.	3580.	38.	0.	0.
1926	2	60000.	44359.	1221.	3580.	37.	0.	0.
1926	3	60000.	45211.	4467.	3580.	36.	0.	0.
1926	4	60000.	49585.	11614.	7166.	74.	0.	0.
1926	5	60000.	49064.	6842.	7166.	197.	0.	0.
1926	6	60000.	60000.	28440.	7166.	244.	10094.	0.
1926	7	60000.	60000.	10870.	7166.	357.	3347.	0.
1926	8	60000.	54160.	1601.	7166.	275.	0.	0.
1926	9	60000.	60000.	43925.	7166.	104.	30816.	0.
1926	10	60000.	60000.	13029.	3580.	110.	9339.	0.
1926	11	60000.	60000.	5740.	3580.	43.	2118.	0.
1926	12	60000.	60000.	3924.	3580.	39.	304.	0.
1927	1	60000.	56951.	573.	3580.	43.	0.	0.
1927	2	60000.	55399.	2070.	3580.	41.	0.	0.
1927	3	60000.	56357.	4579.	3580.	41.	0.	0.

1927	6	60000.	60000.	56436.	7166.	275.	48992.	0.
1927	7	60000.	60000.	17496.	7166.	357.	9973.	0.
1927	8	60000.	60000.	31641.	7166.	275.	24200.	0.
1927	9	60000.	60000.	38044.	7166.	110.	30768.	0.
1927	10	60000.	60000.	23154.	3580.	110.	19464.	0.
1927	11	60000.	60000.	8785.	3580.	43.	5163.	0.
1927	12	60000.	60000.	6700.	3580.	39.	3081.	0.
1928	1	60000.	57010.	633.	3580.	43.	0.	0.
1928	2	60000.	56389.	3000.	3580.	42.	0.	0.
1928	3	60000.	60000.	24494.	3580.	41.	17262.	0.
1928	4	60000.	60000.	12359.	7166.	87.	5106.	0.
1928	5	60000.	60000.	19134.	7166.	221.	11747.	0.
1928	6	60000.	60000.	30673.	7166.	275.	23233.	0.
1928	7	60000.	60000.	38267.	7166.	357.	30744.	0.
1928	8	60000.	57331.	4772.	7166.	275.	0.	0.
1928	9	60000.	55612.	5554.	7166.	107.	0.	0.
1928	10	60000.	56684.	4757.	3580.	105.	0.	0.
1928	11	60000.	55773.	2710.	3580.	41.	0.	0.
1928	12	60000.	53697.	1541.	3580.	38.	0.	0.
1929	1	60000.	50553.	476.	3580.	40.	0.	0.
1929	2	60000.	48007.	1072.	3580.	39.	0.	0.
1929	3	60000.	50100.	5710.	3580.	38.	0.	0.
1929	4	60000.	51715.	8860.	7166.	78.	0.	0.
1929	5	60000.	60000.	30003.	7166.	202.	14351.	0.
1929	6	60000.	60000.	105421.	7166.	275.	97980.	0.
1929	7	60000.	57324.	4847.	7166.	357.	0.	0.
1929	8	60000.	50955.	1065.	7166.	268.	0.	0.
1929	9	60000.	44515.	826.	7166.	100.	0.	0.
1929	10	60000.	42235.	1392.	3580.	92.	0.	0.
1929	11	60000.	39700.	1080.	3580.	35.	0.	0.
1929	12	60000.	36581.	491.	3580.	31.	0.	0.
1930	1	60000.	33356.	387.	3580.	32.	0.	0.
1930	2	60000.	30230.	484.	3580.	30.	0.	0.
1930	3	60000.	31052.	4430.	3580.	29.	0.	0.
1930	4	60000.	41173.	17347.	7166.	59.	0.	0.
1930	5	60000.	57134.	23303.	7166.	177.	0.	0.
1930	6	60000.	60000.	19283.	7166.	267.	8983.	0.
1930	7	60000.	59304.	6827.	7166.	357.	0.	0.
1930	8	60000.	53600.	1735.	7166.	273.	0.	0.
1930	9	60000.	47701.	1370.	7166.	103.	0.	0.
1930	10	60000.	45454.	1429.	3580.	96.	0.	0.
1930	11	60000.	42940.	1102.	3580.	36.	0.	0.
1930	12	60000.	39834.	506.	3580.	32.	0.	0.
1931	1	60000.	36608.	387.	3580.	34.	0.	0.
1931	2	60000.	33487.	491.	3580.	32.	0.	0.
1931	3	60000.	33883.	4005.	3580.	30.	0.	0.
1931	4	60000.	32432.	5777.	7166.	62.	0.	0.
1931	5	60000.	31031.	5919.	7166.	153.	0.	0.
1931	6	60000.	28488.	4809.	7166.	186.	0.	0.
1931	7	60000.	22075.	983.	7166.	230.	0.	0.
1931	8	60000.	15360.	603.	7166.	152.	0.	0.
1931	9	60000.	8867.	722.	7166.	49.	0.	0.
1931	10	60000.	6167.	916.	3580.	36.	0.	0.
1931	11	60000.	3373.	797.	3580.	11.	0.	0.
1931	12	60000.	121.	335.	3580.	7.	0.	0.
1932	1	60000.	0.	357.	3580.	1.	0.	3103.
1932	2	60000.	0.	365.	3580.	0.	0.	3215.
1932	3	60000.	0.	1891.	3580.	0.	0.	1689.
1932	4	60000.	0.	6626.	7166.	0.	0.	540.
1932	5	60000.	11670.	18836.	7166.	0.	0.	0.
1932	6	60000.	60000.	71174.	7166.	105.	15574.	0.
1932	7	60000.	55961.	3484.	7166.	357.	0.	0.
1932	8	60000.	50624.	2092.	7166.	264.	0.	0.
1932	9	60000.	45524.	2166.	7166.	100.	0.	0.

1932	12	60000.	38696.	677.	3580.	42.	0.	0.
1933	1	60000.	35493.	409.	3580.	33.	0.	0.
1933	2	60000.	32485.	603.	3580.	31.	0.	0.
1933	3	60000.	30819.	1943.	3580.	30.	0.	0.
1933	4	60000.	40792.	17198.	7166.	59.	0.	0.
1933	5	60000.	57944.	24494.	7166.	176.	0.	0.
1933	6	60000.	60000.	18836.	7166.	269.	9345.	0.
1933	7	60000.	57085.	4608.	7166.	357.	0.	0.
1933	8	60000.	51640.	1988.	7166.	267.	0.	0.
1933	9	60000.	46220.	1846.	7166.	101.	0.	0.
1933	10	60000.	43901.	1355.	3580.	95.	0.	0.
1933	11	60000.	41342.	1057.	3580.	36.	0.	0.
1933	12	60000.	38207.	476.	3580.	32.	0.	0.
1934	1	60000.	34982.	387.	3580.	33.	0.	0.
1934	2	60000.	31848.	476.	3580.	31.	0.	0.
1934	3	60000.	31879.	3641.	3580.	29.	0.	0.
1934	4	60000.	36044.	11391.	7166.	60.	0.	0.
1934	5	60000.	49412.	20697.	7166.	163.	0.	0.
1934	6	60000.	50414.	8413.	7166.	245.	0.	0.
1934	7	60000.	44995.	2070.	7166.	322.	0.	0.
1934	8	60000.	38126.	529.	7166.	232.	0.	0.
1934	9	60000.	31613.	737.	7166.	84.	0.	0.
1934	10	60000.	29372.	1415.	3580.	76.	0.	0.
1934	11	60000.	26866.	1102.	3580.	28.	0.	0.
1934	12	60000.	23760.	499.	3580.	25.	0.	0.
1935	1	60000.	20543.	387.	3580.	25.	0.	0.
1935	2	60000.	17432.	491.	3580.	23.	0.	0.
1935	3	60000.	15291.	1459.	3580.	21.	0.	0.
1935	4	60000.	16945.	8860.	7166.	39.	0.	0.
1935	5	60000.	18981.	9306.	7166.	105.	0.	0.
1935	6	60000.	22099.	10423.	7166.	139.	0.	0.
1935	7	60000.	19082.	4348.	7166.	198.	0.	0.
1935	8	60000.	13750.	1973.	7166.	140.	0.	0.
1935	9	60000.	7803.	1266.	7166.	46.	0.	0.
1935	10	60000.	5925.	1735.	3580.	33.	0.	0.
1935	11	60000.	3615.	1281.	3580.	11.	0.	0.
1935	12	60000.	631.	603.	3580.	8.	0.	0.
1936	1	60000.	0.	402.	3580.	3.	0.	2550.
1936	2	60000.	0.	558.	3580.	0.	0.	3021.
1936	3	60000.	0.	1437.	3580.	0.	0.	2143.
1936	4	60000.	1991.	9157.	7166.	0.	0.	0.
1936	5	60000.	3134.	8338.	7166.	30.	0.	0.
1936	6	60000.	1750.	5829.	7166.	48.	0.	0.
1936	7	60000.	0.	402.	7166.	44.	0.	5059.
1936	8	60000.	0.	216.	7166.	0.	0.	6950.
1936	9	60000.	0.	104.	7166.	0.	0.	7062.
1936	10	60000.	0.	179.	3580.	0.	0.	3401.
1936	11	60000.	0.	238.	3580.	0.	0.	3342.
1936	12	60000.	0.	74.	3580.	0.	0.	3506.
1937	1	60000.	0.	268.	3580.	0.	0.	3312.
1937	2	60000.	0.	127.	3580.	0.	0.	3453.
1937	3	60000.	0.	134.	3580.	0.	0.	3446.
1937	4	60000.	0.	3395.	7166.	0.	0.	3771.
1937	5	60000.	0.	4958.	7166.	0.	0.	2208.
1937	6	60000.	4448.	11614.	7166.	0.	0.	0.
1937	7	60000.	0.	1846.	7166.	77.	0.	948.
1937	8	60000.	0.	1169.	7166.	0.	0.	5997.
1937	9	60000.	0.	1035.	7166.	0.	0.	6131.
1937	10	60000.	0.	2710.	3580.	0.	0.	870.
1937	11	60000.	0.	1787.	3580.	0.	0.	1793.
1937	12	60000.	0.	916.	3580.	0.	0.	2664.
1938	1	60000.	0.	432.	3580.	0.	0.	3148.
1938	2	60000.	0.	744.	3580.	0.	0.	2835.
1938	3	60000.	0.	2293.	3580.	0.	0.	1287.

1938	6	60000.	56524.	26206.	7166.	209.	0.	0.
1938	7	60000.	58394.	9381.	7166.	345.	0.	0.
1938	8	60000.	52037.	1080.	7166.	270.	0.	0.
1938	9	60000.	45812.	1042.	7166.	101.	0.	0.
1938	10	60000.	43352.	1214.	3580.	94.	0.	0.
1938	11	60000.	40719.	983.	3580.	35.	0.	0.
1938	12	60000.	37540.	432.	3580.	31.	0.	0.
1939	1	60000.	34307.	380.	3580.	32.	0.	0.
1939	2	60000.	31136.	439.	3580.	31.	0.	0.
1939	3	60000.	32218.	4690.	3580.	29.	0.	0.
1939	4	60000.	29391.	4400.	7166.	60.	0.	0.
1939	5	60000.	23525.	1444.	7166.	145.	0.	0.
1939	6	60000.	40025.	23824.	7166.	158.	0.	0.
1939	7	60000.	37856.	5279.	7166.	281.	0.	0.
1939	8	60000.	33816.	3335.	7166.	209.	0.	0.
1939	9	60000.	27614.	1042.	7166.	79.	0.	0.
1939	10	60000.	25781.	1817.	3580.	70.	0.	0.
1939	11	60000.	23500.	1325.	3580.	26.	0.	0.
1939	12	60000.	20523.	625.	3580.	23.	0.	0.
1940	1	60000.	17323.	402.	3580.	23.	0.	0.
1940	2	60000.	14296.	573.	3580.	21.	0.	0.
1940	3	60000.	12053.	1355.	3580.	18.	0.	0.
1940	4	60000.	14755.	9902.	7166.	34.	0.	0.
1940	5	60000.	26998.	19506.	7166.	96.	0.	0.
1940	6	60000.	29637.	9976.	7166.	172.	0.	0.
1940	7	60000.	25281.	3045.	7166.	236.	0.	0.
1940	8	60000.	19029.	1080.	7166.	165.	0.	0.
1940	9	60000.	13311.	1504.	7166.	56.	0.	0.
1940	10	60000.	13081.	3395.	3580.	45.	0.	0.
1940	11	60000.	11598.	2114.	3580.	17.	0.	0.
1940	12	60000.	9128.	1124.	3580.	15.	0.	0.
1941	1	60000.	5988.	454.	3580.	14.	0.	0.
1941	2	60000.	3261.	864.	3580.	11.	0.	0.
1941	3	60000.	2488.	2814.	3580.	8.	0.	0.
1941	4	60000.	0.	3276.	7166.	13.	0.	1416.
1941	5	60000.	0.	5413.	7166.	0.	0.	1753.
1941	6	60000.	5639.	12805.	7166.	0.	0.	0.
1941	7	60000.	0.	1333.	7166.	88.	0.	282.
1941	8	60000.	0.	1080.	7166.	0.	0.	6086.
1941	9	60000.	0.	3827.	7166.	0.	0.	3339.
1941	10	60000.	813.	4393.	3580.	0.	0.	0.
1941	11	60000.	103.	2874.	3580.	3.	0.	0.
1941	12	60000.	0.	1653.	3580.	1.	0.	1824.
1942	1	60000.	0.	484.	3580.	0.	0.	3096.
1942	2	60000.	0.	1132.	3580.	0.	0.	2448.
1942	3	60000.	0.	1705.	3580.	0.	0.	1875.
1942	4	60000.	1843.	9008.	7166.	0.	0.	0.
1942	5	60000.	60000.	79587.	7166.	28.	14235.	0.
1942	6	60000.	60000.	82267.	7166.	275.	74826.	0.
1942	7	60000.	60000.	35140.	7166.	357.	27617.	0.
1942	8	60000.	60000.	18538.	7166.	275.	11097.	0.
1942	9	60000.	60000.	12359.	7166.	110.	5082.	0.
1942	10	60000.	60000.	8413.	3580.	110.	4723.	0.
1942	11	60000.	60000.	4147.	3580.	43.	524.	0.
1942	12	60000.	58994.	2613.	3580.	39.	0.	0.
1943	1	60000.	55900.	529.	3580.	42.	0.	0.
1943	2	60000.	53836.	1556.	3580.	41.	0.	0.
1943	3	60000.	59373.	9157.	3580.	40.	0.	0.
1943	4	60000.	60000.	26802.	7166.	87.	18922.	0.
1943	5	60000.	60000.	18017.	7166.	221.	10630.	0.
1943	6	60000.	60000.	15634.	7166.	275.	8194.	0.
1943	7	60000.	57904.	5427.	7166.	357.	0.	0.
1943	8	60000.	51675.	1206.	7166.	269.	0.	0.
1943	9	60000.	45131.	722.	7166.	101.	0.	0.
1943	10	60000.	42787.	1325.	7166.	87.	0.	0.

1944	1	60000.	33613.	149.	3580.	32.	0.	0.
1944	2	60000.	30152.	149.	3580.	30.	0.	0.
1944	3	60000.	27213.	670.	3580.	29.	0.	0.
1944	4	60000.	26023.	6030.	7166.	55.	0.	0.
1944	5	60000.	22147.	3425.	7166.	135.	0.	0.
1944	6	60000.	18700.	3871.	7166.	153.	0.	0.
1944	7	60000.	13216.	1861.	7166.	180.	0.	0.
1944	8	60000.	6533.	596.	7166.	113.	0.	0.
1944	9	60000.	0.	372.	7166.	30.	0.	291.
1944	10	60000.	0.	670.	3580.	0.	0.	2910.
1944	11	60000.	0.	596.	3580.	0.	0.	2984.
1944	12	60000.	0.	223.	3580.	0.	0.	3356.
1945	1	60000.	0.	74.	3580.	0.	0.	3505.
1945	2	60000.	0.	74.	3580.	0.	0.	3505.
1945	3	60000.	0.	1489.	3580.	0.	0.	2091.
1945	4	60000.	0.	2755.	7166.	0.	0.	4411.
1945	5	60000.	13978.	21144.	7166.	0.	0.	0.
1945	6	60000.	45558.	38863.	7166.	116.	0.	0.
1945	7	60000.	49331.	11242.	7166.	304.	0.	0.
1945	8	60000.	43930.	2010.	7166.	245.	0.	0.
1945	9	60000.	39129.	2457.	7166.	92.	0.	0.
1945	10	60000.	38516.	3052.	3580.	86.	0.	0.
1945	11	60000.	36467.	1563.	3580.	33.	0.	0.
1945	12	60000.	35166.	2308.	3580.	29.	0.	0.
1946	1	60000.	32523.	968.	3580.	31.	0.	0.
1946	2	60000.	30030.	1117.	3580.	30.	0.	0.
1946	3	60000.	30219.	3797.	3580.	28.	0.	0.
1946	4	60000.	28355.	5360.	7166.	58.	0.	0.
1946	5	60000.	29609.	8562.	7166.	142.	0.	0.
1946	6	60000.	48245.	25983.	7166.	181.	0.	0.
1946	7	60000.	46647.	5882.	7166.	314.	0.	0.
1946	8	60000.	41254.	2010.	7166.	237.	0.	0.
1946	9	60000.	38913.	4914.	7166.	88.	0.	0.
1946	10	60000.	39268.	4020.	3580.	85.	0.	0.
1946	11	60000.	38038.	2382.	3580.	33.	0.	0.
1946	12	60000.	35991.	1563.	3580.	30.	0.	0.
1947	1	60000.	33645.	1266.	3580.	32.	0.	0.
1947	2	60000.	33460.	3425.	3580.	30.	0.	0.
1947	3	60000.	39156.	9306.	3580.	30.	0.	0.
1947	4	60000.	55151.	23228.	7166.	68.	0.	0.
1947	5	60000.	60000.	26579.	7166.	210.	14354.	0.
1947	6	60000.	60000.	24568.	7166.	275.	17128.	0.
1947	7	60000.	59475.	6998.	7166.	357.	0.	0.
1947	8	60000.	57545.	5509.	7166.	273.	0.	0.
1947	9	60000.	60000.	11093.	7166.	108.	1365.	0.
1947	10	60000.	60000.	8636.	3580.	110.	4946.	0.
1947	11	60000.	60000.	5286.	3580.	43.	1663.	0.
1947	12	60000.	60000.	4020.	3580.	39.	401.	0.
1948	1	60000.	59132.	2755.	3580.	43.	0.	0.
1948	2	60000.	57669.	2159.	3580.	42.	0.	0.
1948	3	60000.	60000.	10274.	3580.	42.	4322.	0.
1948	4	60000.	60000.	35810.	7166.	87.	28557.	0.
1948	5	60000.	60000.	94998.	7166.	221.	87612.	0.
1948	6	60000.	60000.	65814.	7166.	275.	58373.	0.
1948	7	60000.	60000.	22261.	7166.	357.	14737.	0.
1948	8	60000.	60000.	10051.	7166.	275.	2610.	0.
1948	9	60000.	56967.	4244.	7166.	110.	0.	0.
1948	10	60000.	56557.	3276.	3580.	107.	0.	0.
1948	11	60000.	55020.	2085.	3580.	41.	0.	0.
1948	12	60000.	52073.	670.	3580.	38.	0.	0.
1949	1	60000.	48826.	372.	3580.	39.	0.	0.
1949	2	60000.	45432.	223.	3580.	38.	0.	0.
1949	3	60000.	43230.	1415.	3580.	36.	0.	0.

1949	6	60000.	49745.	8934.	7166.	242.	0.	0.
1949	7	60000.	44940.	2680.	7166.	320.	0.	0.
1949	8	60000.	37840.	298.	7166.	232.	0.	0.
1949	9	60000.	30962.	372.	7166.	84.	0.	0.
1949	10	60000.	28350.	1042.	3580.	75.	0.	0.
1949	11	60000.	26157.	1415.	3580.	27.	0.	0.
1949	12	60000.	23149.	596.	3580.	24.	0.	0.
1950	1	60000.	19694.	149.	3580.	24.	0.	0.
1950	2	60000.	17134.	1042.	3580.	22.	0.	0.
1950	3	60000.	16586.	3052.	3580.	20.	0.	0.
1950	4	60000.	18388.	9008.	7166.	41.	0.	0.
1950	5	60000.	25258.	14145.	7166.	110.	0.	0.
1950	6	60000.	28052.	10125.	7166.	165.	0.	0.
1950	7	60000.	23264.	2606.	7166.	228.	0.	0.
1950	8	60000.	17355.	1415.	7166.	157.	0.	0.
1950	9	60000.	10509.	372.	7166.	53.	0.	0.
1950	10	60000.	7857.	968.	3580.	39.	0.	0.
1950	11	60000.	4860.	596.	3580.	13.	0.	0.
1950	12	60000.	1867.	596.	3580.	9.	0.	0.
1951	1	60000.	0.	447.	3580.	6.	0.	1271.
1951	2	60000.	0.	372.	3580.	0.	0.	3208.
1951	3	60000.	17043.	20623.	3580.	0.	0.	0.
1951	4	60000.	26512.	16677.	7166.	42.	0.	0.
1951	5	60000.	60000.	41766.	7166.	136.	977.	0.
1951	6	60000.	60000.	83012.	7166.	275.	75571.	0.
1951	7	60000.	60000.	35066.	7166.	357.	27543.	0.
1951	8	60000.	60000.	16602.	7166.	275.	9162.	0.
1951	9	60000.	60000.	34470.	7166.	110.	27194.	0.
1951	10	60000.	60000.	22856.	3580.	110.	19166.	0.
1951	11	60000.	60000.	9976.	3580.	43.	6354.	0.
1951	12	60000.	60000.	6105.	3580.	39.	2486.	0.
1952	1	60000.	57792.	1415.	3580.	43.	0.	0.
1952	2	60000.	58637.	4467.	3580.	42.	0.	0.
1952	3	60000.	60000.	12359.	3580.	42.	7374.	0.
1952	4	60000.	60000.	36555.	7166.	87.	29302.	0.
1952	5	60000.	60000.	23079.	7166.	221.	15693.	0.
1952	6	60000.	60000.	24122.	7166.	275.	16681.	0.
1952	7	60000.	60000.	14145.	7166.	357.	6622.	0.
1952	8	60000.	60000.	9455.	7166.	275.	2014.	0.
1952	9	60000.	57414.	4690.	7166.	110.	0.	0.
1952	10	60000.	56854.	3127.	3580.	107.	0.	0.
1952	11	60000.	55392.	2159.	3580.	41.	0.	0.
1952	12	60000.	53040.	1266.	3580.	38.	0.	0.
1953	1	60000.	50239.	819.	3580.	40.	0.	0.
1953	2	60000.	48110.	1489.	3580.	39.	0.	0.
1953	3	60000.	53054.	8562.	3580.	38.	0.	0.
1953	4	60000.	60000.	17496.	7166.	81.	3303.	0.
1953	5	60000.	60000.	55391.	7166.	221.	48004.	0.
1953	6	60000.	60000.	163269.	7166.	275.	155828.	0.
1953	7	60000.	60000.	29482.	7166.	357.	21959.	0.
1953	8	60000.	60000.	8860.	7166.	275.	1419.	0.
1953	9	60000.	57712.	4988.	7166.	110.	0.	0.
1953	10	60000.	57375.	3350.	3580.	108.	0.	0.
1953	11	60000.	56657.	2904.	3580.	42.	0.	0.
1953	12	60000.	54975.	1936.	3580.	38.	0.	0.
1954	1	60000.	53067.	1712.	3580.	41.	0.	0.
1954	2	60000.	52127.	2680.	3580.	40.	0.	0.
1954	3	60000.	50518.	2010.	3580.	39.	0.	0.
1954	4	60000.	57047.	13773.	7166.	79.	0.	0.
1954	5	60000.	60000.	35883.	7166.	214.	25552.	0.
1954	6	60000.	60000.	24047.	7166.	275.	16607.	0.
1954	7	60000.	58731.	6254.	7166.	357.	0.	0.
1954	8	60000.	57398.	6105.	7166.	271.	0.	0.
1954	9	60000.	57198.	7073.	7166.	107.	0.	0.

1954	12	60000.	58912.	2561.	3580.	69.	0.	0.
1955	1	60000.	56258.	968.	3580.	42.	0.	0.
1955	2	60000.	54200.	1563.	3580.	41.	0.	0.
1955	3	60000.	52442.	1861.	3580.	40.	0.	0.
1955	4	60000.	60000.	29854.	7166.	81.	15049.	0.
1955	5	60000.	60000.	62538.	7166.	221.	55152.	0.
1955	6	60000.	60000.	34694.	7166.	275.	27253.	0.
1955	7	60000.	60000.	29706.	7166.	357.	22182.	0.
1955	8	60000.	58292.	5733.	7166.	275.	0.	0.
1955	9	60000.	54442.	3425.	7166.	108.	0.	0.
1955	10	60000.	53960.	3201.	3580.	104.	0.	0.
1955	11	60000.	51680.	1340.	3580.	40.	0.	0.
1955	12	60000.	49776.	1712.	3580.	36.	0.	0.
1956	1	60000.	47573.	1415.	3580.	38.	0.	0.
1956	2	60000.	44775.	819.	3580.	37.	0.	0.
1956	3	60000.	48381.	7222.	3580.	36.	0.	0.
1956	4	60000.	51561.	10423.	7166.	77.	0.	0.
1956	5	60000.	60000.	18612.	7166.	202.	2806.	0.
1956	6	60000.	60000.	8189.	7166.	275.	749.	0.
1956	7	60000.	60000.	14816.	7166.	357.	7292.	0.
1956	8	60000.	55537.	2978.	7166.	275.	0.	0.
1956	9	60000.	50499.	2233.	7166.	105.	0.	0.
1956	10	60000.	48607.	1787.	3580.	100.	0.	0.
1956	11	60000.	46851.	1861.	3580.	38.	0.	0.
1956	12	60000.	44205.	968.	3580.	34.	0.	0.
1957	1	60000.	40961.	372.	3580.	36.	0.	0.
1957	2	60000.	38539.	1191.	3580.	34.	0.	0.
1957	3	60000.	39095.	4169.	3580.	33.	0.	0.
1957	4	60000.	45635.	13773.	7166.	68.	0.	0.
1957	5	60000.	60000.	23079.	7166.	188.	1361.	0.
1957	6	60000.	60000.	15411.	7166.	275.	7970.	0.
1957	7	60000.	55604.	3127.	7166.	357.	0.	0.
1957	8	60000.	49739.	1563.	7166.	263.	0.	0.
1957	9	60000.	43963.	1489.	7166.	99.	0.	0.
1957	10	60000.	42897.	2606.	3580.	92.	0.	0.
1957	11	60000.	41590.	2308.	3580.	35.	0.	0.
1957	12	60000.	39244.	1266.	3580.	32.	0.	0.
1958	1	60000.	36376.	744.	3580.	33.	0.	0.
1958	2	60000.	33583.	819.	3580.	32.	0.	0.
1958	3	60000.	33844.	3871.	3580.	30.	0.	0.
1958	4	60000.	54312.	27695.	7166.	62.	0.	0.
1958	5	60000.	60000.	29482.	7166.	208.	16420.	0.
1958	6	60000.	60000.	19506.	7166.	275.	12065.	0.
1958	7	60000.	60000.	26504.	7166.	357.	18981.	0.
1958	8	60000.	60000.	8189.	7166.	275.	749.	0.
1958	9	60000.	56074.	3350.	7166.	110.	0.	0.
1958	10	60000.	54250.	1861.	3580.	106.	0.	0.
1958	11	60000.	52416.	1787.	3580.	40.	0.	0.
1958	12	60000.	50364.	1563.	3580.	36.	0.	0.
1959	1	60000.	47787.	1042.	3580.	39.	0.	0.
1959	2	60000.	44915.	744.	3580.	37.	0.	0.
1959	3	60000.	52169.	10870.	3580.	36.	0.	0.
1959	4	60000.	57802.	12880.	7166.	80.	0.	0.
1959	5	60000.	60000.	25164.	7166.	216.	15585.	0.
1959	6	60000.	60000.	19431.	7166.	275.	11991.	0.
1959	7	60000.	58061.	5584.	7166.	357.	0.	0.
1959	8	60000.	53156.	2531.	7166.	270.	0.	0.
1959	9	60000.	48717.	2829.	7166.	103.	0.	0.
1959	10	60000.	47497.	2457.	3580.	98.	0.	0.
1959	11	60000.	46783.	2904.	3580.	37.	0.	0.
1959	12	60000.	45179.	2010.	3580.	34.	0.	0.
1960	1	60000.	43127.	1563.	3580.	36.	0.	0.
1960	2	60000.	42118.	2606.	3580.	35.	0.	0.
1960	3	60000.	53542.	15039.	3580.	35.	0.	0.

1960	6	60000.	60000.	10274.	7166.	275.	2933.	0.
1960	7	60000.	54338.	1861.	7166.	357.	0.	0.
1960	8	60000.	48253.	1340.	7166.	259.	0.	0.
1960	9	60000.	41437.	447.	7166.	97.	0.	0.
1960	10	60000.	38513.	744.	3580.	89.	0.	0.
1960	11	60000.	35496.	596.	3580.	33.	0.	0.
1960	12	60000.	32408.	521.	3580.	29.	0.	0.
1961	1	60000.	29469.	670.	3580.	30.	0.	0.
1961	2	60000.	26531.	670.	3580.	28.	0.	0.
1961	3	60000.	24414.	1489.	3580.	26.	0.	0.
1961	4	60000.	20472.	3276.	7166.	51.	0.	0.
1961	5	60000.	25846.	12656.	7166.	117.	0.	0.
1961	6	60000.	23427.	4914.	7166.	167.	0.	0.
1961	7	60000.	17098.	1042.	7166.	205.	0.	0.
1961	8	60000.	10918.	1117.	7166.	131.	0.	0.
1961	9	60000.	4456.	744.	7166.	40.	0.	0.
1961	10	60000.	4277.	3425.	3580.	24.	0.	0.
1961	11	60000.	2922.	2233.	3580.	9.	0.	0.
1961	12	60000.	452.	1117.	3580.	7.	0.	0.
1962	1	60000.	0.	2308.	3580.	2.	0.	822.
1962	2	60000.	68.	3648.	3580.	0.	0.	0.
1962	3	60000.	8251.	11763.	3580.	1.	0.	0.
1962	4	60000.	26148.	25090.	7166.	27.	0.	0.
1962	5	60000.	28972.	10125.	7166.	135.	0.	0.
1962	6	60000.	28327.	6700.	7166.	179.	0.	0.
1962	7	60000.	22793.	1861.	7166.	229.	0.	0.
1962	8	60000.	16068.	596.	7166.	155.	0.	0.
1962	9	60000.	9596.	744.	7166.	51.	0.	0.
1962	10	60000.	6723.	744.	3580.	37.	0.	0.
1962	11	60000.	3801.	670.	3580.	12.	0.	0.
1962	12	60000.	661.	447.	3580.	8.	0.	0.
1963	1	60000.	0.	447.	3580.	3.	0.	2475.
1963	2	60000.	0.	1042.	3580.	0.	0.	2537.
1963	3	60000.	0.	1117.	3580.	0.	0.	2463.
1963	4	60000.	0.	2085.	7166.	0.	0.	5081.
1963	5	60000.	0.	4988.	7166.	0.	0.	2179.
1963	6	60000.	29761.	36927.	7166.	0.	0.	0.
1963	7	60000.	60000.	37672.	7166.	236.	31.	0.
1963	8	60000.	55835.	3276.	7166.	275.	0.	0.
1963	9	60000.	50350.	1787.	7166.	106.	0.	0.
1963	10	60000.	48011.	1340.	3580.	99.	0.	0.
1963	11	60000.	45287.	893.	3580.	38.	0.	0.
1963	12	60000.	42419.	744.	3580.	33.	0.	0.
1964	1	60000.	39102.	298.	3580.	35.	0.	0.
1964	2	60000.	35787.	298.	3580.	33.	0.	0.
1964	3	60000.	32547.	372.	3580.	32.	0.	0.
1964	4	60000.	31277.	5956.	7166.	61.	0.	0.
1964	5	60000.	60000.	36257.	7166.	150.	218.	0.
1964	6	60000.	60000.	21963.	7166.	275.	14522.	0.
1964	7	60000.	58805.	6328.	7166.	357.	0.	0.
1964	8	60000.	52931.	1563.	7166.	272.	0.	0.
1964	9	60000.	48045.	2382.	7166.	102.	0.	0.
1964	10	60000.	46155.	1787.	3580.	97.	0.	0.
1964	11	60000.	43805.	1266.	3580.	37.	0.	0.
1964	12	60000.	40788.	596.	3580.	33.	0.	0.
1965	1	60000.	37546.	372.	3580.	34.	0.	0.
1965	2	60000.	37805.	3871.	3580.	32.	0.	0.
1965	3	60000.	35384.	1191.	3580.	33.	0.	0.
1965	4	60000.	46022.	17868.	7166.	64.	0.	0.
1965	5	60000.	48495.	9827.	7166.	189.	0.	0.
1965	6	60000.	60000.	25685.	7166.	242.	6772.	0.
1965	7	60000.	60000.	19729.	7166.	357.	12206.	0.
1965	8	60000.	57175.	4616.	7166.	275.	0.	0.
1965	9	60000.	56900.	6998.	7166.	107.	0.	0.

1965	12	60000.	54908.	1787.	3580.	38.	0.	0.
1966	1	60000.	52032.	744.	3580.	41.	0.	0.
1966	2	60000.	49307.	893.	3580.	39.	0.	0.
1966	3	60000.	52910.	7222.	3580.	38.	0.	0.
1966	4	60000.	53034.	7371.	7166.	81.	0.	0.
1966	5	60000.	59660.	13997.	7166.	205.	0.	0.
1966	6	60000.	60000.	32162.	7166.	274.	24382.	0.
1966	7	60000.	59773.	7296.	7166.	357.	0.	0.
1966	8	60000.	56577.	4244.	7166.	274.	0.	0.
1966	9	60000.	51016.	1712.	7166.	107.	0.	0.
1966	10	60000.	49421.	2085.	3580.	100.	0.	0.
1966	11	60000.	47515.	1712.	3580.	38.	0.	0.
1966	12	60000.	44646.	744.	3580.	34.	0.	0.
1967	1	60000.	41328.	298.	3580.	36.	0.	0.
1967	2	60000.	38309.	596.	3580.	34.	0.	0.
1967	3	60000.	43854.	9157.	3580.	33.	0.	0.
1967	4	60000.	45252.	8636.	7166.	72.	0.	0.
1967	5	60000.	60000.	62761.	7166.	187.	40661.	0.
1967	6	60000.	60000.	80257.	7166.	275.	72816.	0.
1967	7	60000.	60000.	13252.	7166.	357.	5729.	0.
1967	8	60000.	56282.	3722.	7166.	275.	0.	0.
1967	9	60000.	50052.	1042.	7166.	106.	0.	0.
1967	10	60000.	47490.	1117.	3580.	99.	0.	0.
1967	11	60000.	45138.	1266.	3580.	37.	0.	0.
1967	12	60000.	41972.	447.	3580.	33.	0.	0.
1968	1	60000.	39028.	670.	3580.	35.	0.	0.
1968	2	60000.	36085.	670.	3580.	33.	0.	0.
1968	3	60000.	35451.	2978.	3580.	32.	0.	0.
1968	4	60000.	31348.	3127.	7166.	64.	0.	0.
1968	5	60000.	30286.	6254.	7166.	150.	0.	0.
1968	6	60000.	34997.	12061.	7166.	184.	0.	0.
1968	7	60000.	32411.	4839.	7166.	260.	0.	0.
1968	8	60000.	28478.	3425.	7166.	191.	0.	0.
1968	9	60000.	28537.	7296.	7166.	71.	0.	0.
1968	10	60000.	35980.	11093.	3580.	71.	0.	0.
1968	11	60000.	36686.	4318.	3580.	32.	0.	0.
1968	12	60000.	35608.	2531.	3580.	30.	0.	0.
1969	1	60000.	33709.	1712.	3580.	31.	0.	0.
1969	2	60000.	31514.	1415.	3580.	30.	0.	0.
1969	3	60000.	37136.	9232.	3580.	29.	0.	0.
1969	4	60000.	60000.	40203.	7166.	66.	10108.	0.
1969	5	60000.	60000.	31418.	7166.	221.	24031.	0.
1969	6	60000.	60000.	51222.	7166.	275.	43781.	0.
1969	7	60000.	60000.	64771.	7166.	357.	57248.	0.
1969	8	60000.	59334.	6775.	7166.	275.	0.	0.
1969	9	60000.	55111.	3052.	7166.	110.	0.	0.
1969	10	60000.	54405.	2978.	3580.	105.	0.	0.
1969	11	60000.	53539.	2755.	3580.	40.	0.	0.
1969	12	60000.	51039.	1117.	3580.	37.	0.	0.
1970	1	60000.	48909.	1489.	3580.	39.	0.	0.
1970	2	60000.	47302.	2010.	3580.	38.	0	0
1970	3	60000.	47780.	4095.	3580.	37.	0.	0.
1970	4	60000.	49993.	9455.	7166.	76.	0.	0.
1970	5	60000.	60000.	23079.	7166.	198.	5708.	0.
1970	6	60000.	60000.	29557.	7166.	275.	22116.	0.
1970	7	60000.	60000.	8041.	7166.	357.	518.	0.
1970	8	60000.	53974.	1415.	7166.	275.	0.	0.
1970	9	60000.	47970.	1266.	7166.	104.	0.	0.
1970	10	60000.	46378.	2085.	3580.	97.	0.	0.
1970	11	60000.	43208.	447.	3580.	37.	0.	0.
1970	12	60000.	40340.	744.	3580.	33.	0.	0.
1971	1	60000.	40747.	4020.	3580.	34.	0.	0.
1971	2	60000.	45546.	8413.	3580.	34.	0.	0.
1971	3	60000.	47886.	5956.	3580.	36.	0.	0.

1971	6	60000.	60000.	17742.	7166.	273.	10302.	0.
1971	7	60000.	55380.	2904.	7166.	357.	0.	0.
1971	8	60000.	48101.	149.	7166.	262.	0.	0.
1971	9	60000.	41583.	744.	7166.	97.	0.	0.
1971	10	60000.	39478.	1563.	3580.	89.	0.	0.
1971	11	60000.	36833.	968.	3580.	33.	0.	0.
1971	12	60000.	33298.	74.	3580.	30.	0.	0.
1972	1	60000.	29837.	149.	3580.	30.	0.	0.
1972	2	60000.	26973.	744.	3580.	28.	0.	0.
1972	3	60000.	40788.	17421.	3580.	27.	0.	0.
1972	4	60000.	58270.	24717.	7166.	69.	0.	0.
1972	5	60000.	60000.	44670.	7166.	217.	35557.	0.
1972	6	60000.	60000.	21069.	7166.	275.	13629.	0.
1972	7	60000.	58433.	5956.	7166.	357.	0.	0.
1972	8	60000.	60000.	9604.	7166.	271.	600.	0.
1972	9	60000.	58680.	5956.	7166.	110.	0.	0.
1972	10	60000.	60000.	5137.	3580.	109.	128.	0.
1972	11	60000.	60000.	4318.	3580.	43.	696.	0.
1972	12	60000.	58391.	2010.	3580.	39.	0.	0.
1973	1	60000.	57747.	2978.	3580.	42.	0.	0.
1973	2	60000.	57625.	3499.	3580.	42.	0.	0.
1973	3	60000.	59587.	5584.	3580.	42.	0.	0.
1973	4	60000.	60000.	13252.	7166.	87.	5586.	0.
1973	5	60000.	60000.	30301.	7166.	221.	22915.	0.
1973	6	60000.	60000.	18985.	7166.	275.	11544.	0.
1973	7	60000.	56721.	4244.	7166.	357.	0.	0.
1973	8	60000.	51373.	2085.	7166.	266.	0.	0.
1973	9	60000.	45894.	1787.	7166.	101.	0.	0.
1973	10	60000.	43932.	1712.	3580.	94.	0.	0.
1973	11	60000.	41508.	1191.	3580.	36.	0.	0.
1973	12	60000.	39088.	1191.	3580.	32.	0.	0.
1974	1	60000.	36368.	893.	3580.	33.	0.	0.
1974	2	60000.	34096.	1340.	3580.	32.	0.	0.
1974	3	60000.	38676.	8189.	3580.	31.	0.	0.
1974	4	60000.	47523.	16081.	7166.	67.	0.	0.
1974	5	60000.	60000.	57699.	7166.	192.	37864.	0.
1974	6	60000.	60000.	32013.	7166.	275.	24573.	0.
1974	7	60000.	58582.	6105.	7166.	357.	0.	0.
1974	8	60000.	55612.	4467.	7166.	271.	0.	0.
1974	9	60000.	51691.	3350.	7166.	105.	0.	0.
1974	10	60000.	50914.	2904.	3580.	101.	0.	0.
1974	11	60000.	49231.	1936.	3580.	39.	0.	0.
1974	12	60000.	47254.	1638.	3580.	35.	0.	0.
1975	1	60000.	44754.	1117.	3580.	37.	0.	0.
1975	2	60000.	42999.	1861.	3580.	36.	0.	0.
1975	3	60000.	43181.	3797.	3580.	35.	0.	0.
1975	4	60000.	57236.	21293.	7166.	72.	0.	0.
1975	5	60000.	60000.	46829.	7166.	214.	36685.	0.
1975	6	60000.	60000.	43777.	7166.	275.	36336.	0.
1975	7	60000.	60000.	18389.	7166.	357.	10866.	0.
1975	8	60000.	59185.	6626.	7166.	275.	0.	0.
1975	9	60000.	54888.	2978.	7166.	109.	0.	0.
1975	10	60000.	53958.	2755.	3580.	105.	0.	0.
1975	11	60000.	51902.	1563.	3580.	40.	0.	0.
1975	12	60000.	49551.	1266.	3580.	36.	0.	0.
1976	1	60000.	48614.	2680.	3580.	38.	0.	0.
1976	2	60000.	46038.	1042.	3580.	38.	0.	0.
1976	3	60000.	50984.	8562.	3580.	37.	0.	0.
1976	4	60000.	54087.	10349.	7166.	79.	0.	0.
1976	5	60000.	59966.	13252.	7166.	207.	0.	0.
1976	6	60000.	59672.	7147.	7166.	275.	0.	0.
1976	7	60000.	54141.	2010.	7166.	356.	0.	0.
1976	8	60000.	60000.	23154.	7166.	259.	9990.	0.
1976	9	60000.	56074.	3350.	7166.	110.	0.	0.

1976	12	60000.	49942.	1415.	3580.	34.	0.	0.
1977	1	60000.	47937.	1712.	3580.	38.	0.	0.
1977	2	60000.	44841.	521.	3580.	37.	0.	0.
1977	3	60000.	43160.	1936.	3580.	36.	0.	0.
1977	4	60000.	41134.	5211.	7166.	72.	0.	0.
1977	5	60000.	36770.	2978.	7166.	176.	0.	0.
1977	6	60000.	30515.	1117.	7166.	206.	0.	0.
1977	7	60000.	23109.	0.	7166.	240.	0.	0.
1977	8	60000.	16829.	1042.	7166.	157.	0.	0.
1977	9	60000.	10653.	1042.	7166.	52.	0.	0.
1977	10	60000.	8225.	1191.	3580.	40.	0.	0.
1977	11	60000.	4781.	149.	3580.	13.	0.	0.
1977	12	60000.	1490.	298.	3580.	9.	0.	0.
1978	1	60000.	0.	149.	3580.	5.	0.	1946.
1978	2	60000.	0.	402.	3580.	0.	0.	3178.
1978	3	60000.	5652.	9232.	3580.	0.	0.	0.
1978	4	60000.	7994.	9530.	7166.	22.	0.	0.
1978	5	60000.	34636.	33875.	7166.	67.	0.	0.
1978	6	60000.	53999.	26728.	7166.	199.	0.	0.
1978	7	60000.	60000.	14667.	7166.	336.	1164.	0.
1978	8	60000.	58292.	5733.	7166.	275.	0.	0.
1978	9	60000.	56006.	4988.	7166.	108.	0.	0.
1978	10	60000.	54926.	2606.	3580.	106.	0.	0.
1978	11	60000.	53688.	2382.	3580.	41.	0.	0.
1978	12	60000.	51262.	1191.	3580.	37.	0.	0.

NUMBER OF YEARS OF RESERVOIR DEPLETION = 13

UMBER OF YEARS OF SPILL = 44

ESERVOIR CAPACITY = 80000. DAM**3

YEAR	MONTH	RES. CAP. DAM**3	STORAGE DAM**3	INFLOW DAM**3	DEMAND DAM**3	EVAP DAM**3	SPILL DAM**3	DEFICIT DAM**3
1912	1	80000.	76824.	454.	3580.	51.	0.	0.
1912	2	80000.	73790.	596.	3580.	50.	0.	0.
1912	3	80000.	77264.	7103.	3580.	48.	0.	0.
1912	4	80000.	80000.	10646.	7166.	101.	644.	0.
1912	5	80000.	80000.	19506.	7166.	261.	12079.	0.
1912	6	80000.	80000.	22186.	7166.	326.	14694.	0.
1912	7	80000.	80000.	24717.	7166.	423.	17129.	0.
1912	8	80000.	80000.	16007.	7166.	326.	8515.	0.
1912	9	80000.	79940.	7237.	7166.	131.	0.	0.
1912	10	80000.	80000.	5725.	3580.	131.	1955.	0.
1912	11	80000.	79482.	3112.	3580.	51.	0.	0.
1912	12	80000.	77679.	1824.	3580.	47.	0.	0.
1913	1	80000.	74541.	491.	3580.	50.	0.	0.
1913	2	80000.	72126.	1214.	3580.	49.	0.	0.
1913	3	80000.	70859.	2360.	3580.	48.	0.	0.
1913	4	80000.	80000.	23377.	7166.	96.	6974.	0.
1913	5	80000.	80000.	24866.	7166.	261.	17439.	0.
1913	6	80000.	80000.	18836.	7166.	326.	11344.	0.
1913	7	80000.	80000.	15560.	7166.	423.	7971.	0.
1913	8	80000.	80000.	10274.	7166.	326.	2782.	0.
1913	9	80000.	77602.	4899.	7166.	131.	0.	0.

1913	12	80000.	74858.	1400.	3580.	44.	0.	0.
1914	1	80000.	71699.	469.	3580.	49.	0.	0.
1914	2	80000.	69076.	1005.	3580.	48.	0.	0.
1914	3	80000.	67765.	2315.	3580.	46.	0.	0.
1914	4	80000.	70929.	10423.	7166.	94.	0.	0.
1914	5	80000.	74091.	10572.	7166.	243.	0.	0.
1914	6	80000.	76218.	9604.	7166.	311.	0.	0.
1914	7	80000.	75245.	6604.	7166.	411.	0.	0.
1914	8	80000.	69343.	1579.	7166.	314.	0.	0.
1914	9	80000.	63263.	1206.	7166.	120.	0.	0.
1914	10	80000.	65458.	5889.	3580.	114.	0.	0.
1914	11	80000.	65013.	3179.	3580.	45.	0.	0.
1914	12	80000.	63268.	1876.	3580.	41.	0.	0.
1915	1	80000.	60143.	499.	3580.	44.	0.	0.
1915	2	80000.	57756.	1236.	3580.	43.	0.	0.
1915	3	80000.	57343.	3209.	3580.	42.	0.	0.
1915	4	80000.	57761.	7668.	7166.	85.	0.	0.
1915	5	80000.	80000.	57699.	7166.	216.	28078.	0.
1915	6	80000.	80000.	81895.	7166.	326.	74403.	0.
1915	7	80000.	80000.	57773.	7166.	423.	50184.	0.
1915	8	80000.	80000.	31343.	7166.	326.	23852.	0.
1915	9	80000.	80000.	14890.	7166.	131.	7593.	0.
1915	10	80000.	80000.	8338.	3580.	131.	4628.	0.
1915	11	80000.	80000.	4147.	3580.	51.	516.	0.
1915	12	80000.	79880.	3507.	3580.	47.	0.	0.
1916	1	80000.	76741.	491.	3580.	51.	0.	0.
1916	2	80000.	75539.	2427.	3580.	49.	0.	0.
1916	3	80000.	79578.	7668.	3580.	49.	0.	0.
1916	4	80000.	80000.	12508.	7166.	103.	4817.	0.
1916	5	80000.	80000.	20474.	7166.	261.	13046.	0.
1916	6	80000.	80000.	64995.	7166.	326.	57503.	0.
1916	7	80000.	80000.	29110.	7166.	423.	21521.	0.
1916	8	80000.	80000.	9530.	7166.	326.	2038.	0.
1916	9	80000.	80000.	12061.	7166.	131.	4764.	0.
1916	10	80000.	80000.	10423.	3580.	131.	6713.	0.
1916	11	80000.	80000.	5211.	3580.	51.	1581.	0.
1916	12	80000.	79910.	3536.	3580.	47.	0.	0.
1917	1	80000.	76860.	581.	3580.	51.	0.	0.
1917	2	80000.	74407.	1176.	3580.	50.	0.	0.
1917	3	80000.	74010.	3231.	3580.	49.	0.	0.
1917	4	80000.	80000.	22261.	7166.	99.	9006.	0.
1917	5	80000.	80000.	77056.	7166.	261.	69628.	0.
1917	6	80000.	80000.	93509.	7166.	326.	86018.	0.
1917	7	80000.	80000.	19878.	7166.	423.	12289.	0.
1917	8	80000.	80000.	8711.	7166.	326.	1219.	0.
1917	9	80000.	78019.	5316.	7166.	131.	0.	0.
1917	10	80000.	78450.	4139.	3580.	129.	0.	0.
1917	11	80000.	77999.	3179.	3580.	50.	0.	0.
1917	12	80000.	75378.	1005.	3580.	46.	0.	0.
1918	1	80000.	72248.	499.	3580.	49.	0.	0.
1918	2	80000.	69872.	1251.	3580.	48.	0.	0.
1918	3	80000.	70280.	4035.	3580.	47.	0.	0.
1918	4	80000.	69086.	6068.	7166.	96.	0.	0.
1918	5	80000.	71880.	10200.	7166.	240.	0.	0.
1918	6	80000.	71846.	7438.	7166.	306.	0.	0.
1918	7	80000.	66100.	1817.	7166.	397.	0.	0.
1918	8	80000.	59797.	1154.	7166.	291.	0.	0.
1918	9	80000.	54531.	2010.	7166.	110.	0.	0.
1918	10	80000.	52879.	2032.	3580.	104.	0.	0.
1918	11	80000.	50187.	923.	3580.	40.	0.	0.
1918	12	80000.	46880.	313.	3580.	36.	0.	0.
1919	1	80000.	43681.	417.	3580.	37.	0.	0.
1919	2	80000.	40505.	479.	3580.	35.	0.	0.
1919	3	80000.	37263.	372.	3580.	34.	0.	0.

[illegible]	8	80000.	[illegible]	[illegible]	7166.	212.	0.	0.
1919	7	80000.	27316.	275.	7166.	257.	0.	0.
1919	8	80000.	20461.	484.	7166.	173.	0.	0.
1919	9	80000.	13683.	447.	7166.	58.	0.	0.
1919	10	80000.	11167.	1109.	3580.	46.	0.	0.
1919	11	80000.	9179.	1608.	3580.	16.	0.	0.
1919	12	80000.	6182.	596.	3580.	13.	0.	0.
1920	1	80000.	3038.	447.	3580.	11.	0.	0.
1920	2	80000.	128.	677.	3580.	7.	0.	0.
1920	3	80000.	1484.	4936.	3580.	1.	0.	0.
1920	4	80000.	10761.	16453.	7166.	10.	0.	0.
1920	5	80000.	72977.	69462.	7166.	80.	0.	0.
1920	6	80000.	80000.	31790.	7166.	308.	17293.	0.
1920	7	80000.	80000.	10721.	7166.	423.	3132.	0.
1920	8	80000.	74839.	2330.	7166.	326.	0.	0.
1920	9	80000.	68753.	1206.	7166.	126.	0.	0.
1920	10	80000.	66640.	1586.	3580.	119.	0.	0.
1920	11	80000.	64265.	1251.	3580.	46.	0.	0.
1920	12	80000.	61165.	521.	3580.	41.	0.	0.
1921	1	80000.	57848.	305.	3580.	43.	0.	0.
1921	2	80000.	55015.	789.	3580.	42.	0.	0.
1921	3	80000.	54209.	2814.	3580.	41.	0.	0.
1921	4	80000.	56863.	9902.	7166.	82.	0.	0.
1921	5	80000.	60353.	10870.	7166.	214.	0.	0.
1921	6	80000.	60051.	7140.	7166.	276.	0.	0.
1921	7	80000.	54739.	2211.	7166.	357.	0.	0.
1921	8	80000.	47849.	536.	7166.	260.	0.	0.
1921	9	80000.	41144.	558.	7166.	96.	0.	0.
1921	10	80000.	38750.	1273.	3580.	88.	0.	0.
1921	11	80000.	35904.	767.	3580.	33.	0.	0.
1921	12	80000.	32734.	439.	3580.	29.	0.	0.
1922	1	80000.	29385.	261.	3580.	30.	0.	0.
1922	2	80000.	25845.	68.	3580.	28.	0.	0.
1922	3	80000.	22567.	328.	3580.	26.	0.	0.
1922	4	80000.	28083.	12731.	7166.	49.	0.	0.
1922	5	80000.	44749.	23973.	7166.	141.	0.	0.
1922	6	80000.	47775.	10423.	7166.	231.	0.	0.
1922	7	80000.	44987.	4690.	7166.	312.	0.	0.
1922	8	80000.	38691.	1102.	7166.	232.	0.	0.
1922	9	80000.	31887.	447.	7166.	85.	0.	0.
1922	10	80000.	29058.	826.	3580.	76.	0.	0.
1922	11	80000.	26090.	640.	3580.	28.	0.	0.
1922	12	80000.	22658.	171.	3580.	24.	0.	0.
1923	1	80000.	19359.	305.	3580.	24.	0.	0.
1923	2	80000.	15826.	68.	3580.	22.	0.	0.
1923	3	80000.	12993.	767.	3580.	19.	0.	0.
1923	4	80000.	11532.	5740.	7166.	35.	0.	0.
1923	5	80000.	13217.	8934.	7166.	83.	0.	0.
1923	6	80000.	80000.	110558.	7166.	113.	36497.	0.
1923	7	80000.	80000.	32311.	7166.	423.	24722.	0.
1923	8	80000.	80000.	15262.	7166.	326.	7771.	0.
1923	9	80000.	78540.	5837.	7166.	131.	0.	0.
1923	10	80000.	78502.	3670.	3580.	129.	0.	0.
1923	11	80000.	77105.	2233.	3580.	50.	0.	0.
1923	12	80000.	74686.	1206.	3580.	46.	0.	0.
1924	1	80000.	71511.	454.	3580.	49.	0.	0.
1924	2	80000.	68793.	908.	3580.	47.	0.	0.
1924	3	80000.	68733.	3566.	3580.	46.	0.	0.
1924	4	80000.	68671.	7199.	7166.	95.	0.	0.
1924	5	80000.	77646.	16379.	7166.	239.	0.	0.
1924	6	80000.	80000.	41096.	7166.	320.	31256.	0.
1924	7	80000.	80000.	7966.	7166.	423.	377.	0.
1924	8	80000.	80000.	13922.	7166.	326.	6431.	0.
1924	9	80000.	75078.	2375.	7166.	131.	0.	0.
[illegible]	10	80000.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1924	12	80000.	68439.	722.	3580.	44.	0.	0.
1925	1	80000.	65230.	417.	3580.	46.	0.	0.
1925	2	80000.	62238.	633.	3580.	45.	0.	0.
1925	3	80000.	65650.	7036.	3580.	44.	0.	0.
1925	4	80000.	70304.	11912.	7166.	92.	0.	0.
1925	5	80000.	78978.	16081.	7166.	242.	0.	0.
1925	6	80000.	80000.	28663.	7166.	323.	20152.	0.
1925	7	80000.	77235.	4824.	7166.	423.	0.	0.
1925	8	80000.	72408.	2658.	7166.	319.	0.	0.
1925	9	80000.	69839.	4720.	7166.	123.	0.	0.
1925	10	80000.	71946.	5807.	3580.	121.	0.	0.
1925	11	80000.	71468.	3149.	3580.	48.	0.	0.
1925	12	80000.	69698.	1854.	3580.	44.	0.	0.
1926	1	80000.	66570.	499.	3580.	47.	0.	0.
1926	2	80000.	64166.	1221.	3580.	45.	0.	0.
1926	3	80000.	65009.	4467.	3580.	45.	0.	0.
1926	4	80000.	69366.	11614.	7166.	91.	0.	0.
1926	5	80000.	68801.	6842.	7166.	240.	0.	0.
1926	6	80000.	80000.	28440.	7166.	298.	9777.	0.
1926	7	80000.	80000.	10870.	7166.	423.	3281.	0.
1926	8	80000.	74109.	1601.	7166.	326.	0.	0.
1926	9	80000.	80000.	43925.	7166.	125.	30744.	0.
1926	10	80000.	80000.	13029.	3580.	131.	9318.	0.
1926	11	80000.	80000.	5740.	3580.	51.	2110.	0.
1926	12	80000.	80000.	3924.	3580.	47.	297.	0.
1927	1	80000.	76943.	573.	3580.	51.	0.	0.
1927	2	80000.	75383.	2070.	3580.	50.	0.	0.
1927	3	80000.	76333.	4579.	3580.	49.	0.	0.
1927	4	80000.	77107.	8041.	7166.	101.	0.	0.
1927	5	80000.	80000.	37299.	7166.	256.	26985.	0.
1927	6	80000.	80000.	56433.	7166.	326.	48941.	0.
1927	7	80000.	80000.	17496.	7166.	423.	9907.	0.
1927	8	80000.	80000.	31641.	7166.	326.	24150.	0.
1927	9	80000.	80000.	38044.	7166.	131.	30747.	0.
1927	10	80000.	80000.	23154.	3580.	131.	19444.	0.
1927	11	80000.	80000.	8785.	3580.	51.	5155.	0.
1927	12	80000.	80000.	6700.	3580.	47.	3074.	0.
1928	1	80000.	77002.	633.	3580.	51.	0.	0.
1928	2	80000.	76373.	3000.	3580.	50.	0.	0.
1928	3	80000.	80000.	24494.	3580.	49.	17238.	0.
1928	4	80000.	80000.	12359.	7166.	103.	5089.	0.
1928	5	80000.	80000.	19134.	7166.	261.	11706.	0.
1928	6	80000.	80000.	30673.	7166.	326.	23182.	0.
1928	7	80000.	80000.	38267.	7166.	423.	30678.	0.
1928	8	80000.	77281.	4772.	7166.	326.	0.	0.
1928	9	80000.	75541.	5554.	7166.	128.	0.	0.
1928	10	80000.	76592.	4757.	3580.	126.	0.	0.
1928	11	80000.	75673.	2710.	3580.	49.	0.	0.
1928	12	80000.	73589.	1541.	3580.	45.	0.	0.
1929	1	80000.	70437.	476.	3580.	48.	0.	0.
1929	2	80000.	67882.	1072.	3580.	47.	0.	0.
1929	3	80000.	69967.	5710.	3580.	46.	0.	0.
1929	4	80000.	71565.	8860.	7166.	96.	0.	0.
1929	5	80000.	80000.	30003.	7166.	245.	14158.	0.
1929	6	80000.	80000.	105421.	7166.	326.	97930.	0.
1929	7	80000.	77258.	4847.	7166.	423.	0.	0.
1929	8	80000.	70837.	1065.	7166.	319.	0.	0.
1929	9	80000.	64376.	826.	7166.	122.	0.	0.
1929	10	80000.	62074.	1392.	3580.	115.	0.	0.
1929	11	80000.	59530.	1080.	3580.	44.	0.	0.
1929	12	80000.	56402.	491.	3580.	39.	0.	0.
1930	1	80000.	53168.	387.	3580.	41.	0.	0.
1930	2	80000.	50032.	484.	3580.	40.	0.	0.
1930	3	80000.	50844.	4430.	3580.	38.	0.	0.

1930	7	80000.	79238.	6827.	7166.	423.	0.	0.
1930	8	80000.	73483.	1735.	7166.	324.	0.	0.
1930	9	80000.	67562.	1370.	7166.	124.	0.	0.
1930	10	80000.	65294.	1429.	3580.	118.	0.	0.
1930	11	80000.	62771.	1102.	3580.	45.	0.	0.
1930	12	80000.	59657.	506.	3580.	41.	0.	0.
1931	1	80000.	56422.	387.	3580.	43.	0.	0.
1931	2	80000.	53292.	491.	3580.	41.	0.	0.
1931	3	80000.	53678.	4005.	3580.	40.	0.	0.
1931	4	80000.	52208.	5777.	7166.	82.	0.	0.
1931	5	80000.	50757.	5919.	7166.	203.	0.	0.
1931	6	80000.	48152.	4809.	7166.	249.	0.	0.
1931	7	80000.	41655.	983.	7166.	314.	0.	0.
1931	8	80000.	34870.	603.	7166.	222.	0.	0.
1931	9	80000.	28346.	722.	7166.	80.	0.	0.
1931	10	80000.	25612.	916.	3580.	71.	0.	0.
1931	11	80000.	22803.	797.	3580.	26.	0.	0.
1931	12	80000.	19536.	335.	3580.	22.	0.	0.
1932	1	80000.	16291.	357.	3580.	22.	0.	0.
1932	2	80000.	13056.	365.	3580.	20.	0.	0.
1932	3	80000.	11350.	1891.	3580.	17.	0.	0.
1932	4	80000.	10778.	6626.	7166.	33.	0.	0.
1932	5	80000.	22367.	18836.	7166.	80.	0.	0.
1932	6	80000.	80000.	71174.	7166.	154.	6222.	0.
1932	7	80000.	75895.	3484.	7166.	423.	0.	0.
1932	8	80000.	70506.	2092.	7166.	316.	0.	0.
1932	9	80000.	65385.	2166.	7166.	121.	0.	0.
1932	10	80000.	63669.	1980.	3580.	116.	0.	0.
1932	11	80000.	61460.	1415.	3580.	44.	0.	0.
1932	12	80000.	58518.	677.	3580.	40.	0.	0.
1933	1	80000.	55305.	409.	3580.	42.	0.	0.
1933	2	80000.	52288.	603.	3580.	41.	0.	0.
1933	3	80000.	50612.	1943.	3580.	39.	0.	0.
1933	4	80000.	60565.	17198.	7166.	79.	0.	0.
1933	5	80000.	77671.	24494.	7166.	222.	0.	0.
1933	6	80000.	80000.	18836.	7166.	320.	9021.	0.
1933	7	80000.	77019.	4608.	7166.	423.	0.	0.
1933	8	80000.	71523.	1988.	7166.	318.	0.	0.
1933	9	80000.	66081.	1846.	7166.	122.	0.	0.
1933	10	80000.	63739.	1355.	3580.	117.	0.	0.
1933	11	80000.	61172.	1057.	3580.	44.	0.	0.
1933	12	80000.	58029.	476.	3580.	40.	0.	0.
1934	1	80000.	54795.	387.	3580.	42.	0.	0.
1934	2	80000.	51651.	476.	3580.	41.	0.	0.
1934	3	80000.	51672.	3641.	3580.	39.	0.	0.
1934	4	80000.	55817.	11391.	7166.	80.	0.	0.
1934	5	80000.	69137.	20697.	7166.	211.	0.	0.
1934	6	80000.	70085.	8413.	7166.	299.	0.	0.
1934	7	80000.	64598.	2070.	7166.	391.	0.	0.
1934	8	80000.	57673.	529.	7166.	287.	0.	0.
1934	9	80000.	51137.	737.	7166.	108.	0.	0.
1934	10	80000.	48871.	1415.	3580.	100.	0.	0.
1934	11	80000.	46355.	1102.	3580.	38.	0.	0.
1934	12	80000.	43240.	499.	3580.	34.	0.	0.
1935	1	80000.	40013.	387.	3580.	35.	0.	0.
1935	2	80000.	36891.	491.	3580.	34.	0.	0.
1935	3	80000.	34738.	1459.	3580.	32.	0.	0.
1935	4	80000.	36368.	8860.	7166.	63.	0.	0.
1935	5	80000.	38344.	9306.	7166.	164.	0.	0.
1935	6	80000.	41390.	10423.	7166.	211.	0.	0.
1935	7	80000.	38286.	4348.	7166.	287.	0.	0.
1935	8	80000.	32882.	1973.	7166.	211.	0.	0.
1935	9	80000.	26904.	1266.	7166.	77.	0.	0.

1935	12	80000.	19667.	603.	3580.	22.	0.	0.
1936	1	80000.	16467.	402.	3580.	22.	0.	0.
1936	2	80000.	13425.	558.	3580.	20.	0.	0.
1936	3	80000.	11265.	1437.	3580.	19.	0.	0.
1936	4	80000.	13224.	9157.	7166.	33.	0.	0.
1936	5	80000.	14306.	8338.	7166.	90.	0.	0.
1936	6	80000.	12851.	5829.	7166.	118.	0.	0.
1936	7	80000.	5944.	402.	7166.	144.	0.	0.
1936	8	80000.	0.	216.	7166.	70.	0.	1077.
1936	9	80000.	0.	104.	7166.	0.	0.	7062.
1936	10	80000.	0.	179.	3580.	0.	0.	3401.
1936	11	80000.	0.	238.	3580.	0.	0.	3342.
1936	12	80000.	0.	74.	3580.	0.	0.	3506.
1937	1	80000.	0.	268.	3580.	0.	0.	3312.
1937	2	80000.	0.	127.	3580.	0.	0.	3453.
1937	3	80000.	0.	134.	3580.	0.	0.	3446.
1937	4	80000.	0.	3395.	7166.	0.	0.	3771.
1937	5	80000.	0.	4958.	7166.	0.	0.	2208.
1937	6	80000.	4448.	11614.	7166.	0.	0.	0.
1937	7	80000.	0.	1846.	7166.	77.	0.	948.
1937	8	80000.	0.	1169.	7166.	0.	0.	5997.
1937	9	80000.	0.	1035.	7166.	0.	0.	6131.
1937	10	80000.	0.	2710.	3580.	0.	0.	870.
1937	11	80000.	0.	1787.	3580.	0.	0.	1793.
1937	12	80000.	0.	916.	3580.	0.	0.	2664.
1938	1	80000.	0.	432.	3580.	0.	0.	3148.
1938	2	80000.	0.	744.	3580.	0.	0.	2835.
1938	3	80000.	0.	2293.	3580.	0.	0.	1287.
1938	4	80000.	726.	7892.	7166.	0.	0.	0.
1938	5	80000.	37692.	44149.	7166.	16.	0.	0.
1938	6	80000.	56524.	26206.	7166.	209.	0.	0.
1938	7	80000.	58394.	9381.	7166.	345.	0.	0.
1938	8	80000.	52037.	1080.	7166.	270.	0.	0.
1938	9	80000.	45812.	1042.	7166.	101.	0.	0.
1938	10	80000.	43352.	1214.	3580.	94.	0.	0.
1938	11	80000.	40719.	983.	3580.	35.	0.	0.
1938	12	80000.	37540.	432.	3580.	31.	0.	0.
1939	1	80000.	34307.	380.	3580.	32.	0.	0.
1939	2	80000.	31136.	439.	3580.	31.	0.	0.
1939	3	80000.	32218.	4690.	3580.	29.	0.	0.
1939	4	80000.	29391.	4400.	7166.	60.	0.	0.
1939	5	80000.	23525.	1444.	7166.	145.	0.	0.
1939	6	80000.	40025.	23824.	7166.	158.	0.	0.
1939	7	80000.	37856.	5279.	7166.	281.	0.	0.
1939	8	80000.	33816.	3335.	7166.	209.	0.	0.
1939	9	80000.	27614.	1042.	7166.	79.	0.	0.
1939	10	80000.	25781.	1817.	3580.	70.	0.	0.
1939	11	80000.	23500.	1325.	3580.	26.	0.	0.
1939	12	80000.	20523.	625.	3580.	23.	0.	0.
1940	1	80000.	17323.	402.	3580.	23.	0.	0.
1940	2	80000.	14296.	573.	3580.	21.	0.	0.
1940	3	80000.	12053.	1355.	3580.	18.	0.	0.
1940	4	80000.	14755.	9902.	7166.	34.	0.	0.
1940	5	80000.	26998.	19506.	7166.	96.	0.	0.
1940	6	80000.	29637.	9976.	7166.	172.	0.	0.
1940	7	80000.	25281.	3045.	7166.	236.	0.	0.
1940	8	80000.	19029.	1080.	7166.	165.	0.	0.
1940	9	80000.	13311.	1504.	7166.	56.	0.	0.
1940	10	80000.	13081.	3395.	3580.	45.	0.	0.
1940	11	80000.	11598.	2114.	3580.	17.	0.	0.
1940	12	80000.	9128.	1124.	3580.	15.	0.	0.
1941	1	80000.	5988.	454.	3580.	14.	0.	0.
1941	2	80000.	3261.	864.	3580.	11.	0.	0.
1941	3	80000.	2488.	2814.	3580.	8.	0.	0.

1941	7	80000.	0.	1333.	7166.	98.	0.	297.
1941	8	80000.	0.	1080.	7166.	0.	0.	6086.
1941	9	80000.	0.	3827.	7166.	0.	0.	3339.
1941	10	80000.	813.	4393.	3580.	0.	0.	0.
1941	11	80000.	103.	2874.	3580.	3.	0.	0.
1941	12	80000.	0.	1653.	3580.	1.	0.	1824.
1942	1	80000.	0.	484.	3580.	0.	0.	3096.
1942	2	80000.	0.	1132.	3580.	0.	0.	2448.
1942	3	80000.	0.	1705.	3580.	0.	0.	1875.
1942	4	80000.	1843.	9008.	7166.	0.	0.	0.
1942	5	80000.	74235.	79587.	7166.	28.	0.	0.
1942	6	80000.	80000.	82267.	7166.	312.	69025.	0.
1942	7	80000.	80000.	35140.	7166.	423.	27551.	0.
1942	8	80000.	80000.	18538.	7166.	326.	11046.	0.
1942	9	80000.	80000.	12359.	7166.	131.	5062.	0.
1942	10	80000.	80000.	8413.	3580.	131.	4702.	0.
1942	11	80000.	80000.	4147.	3580.	51.	516.	0.
1942	12	80000.	78987.	2613.	3580.	47.	0.	0.
1943	1	80000.	75885.	529.	3580.	50.	0.	0.
1943	2	80000.	73812.	1556.	3580.	49.	0.	0.
1943	3	80000.	79341.	9157.	3580.	48.	0.	0.
1943	4	80000.	80000.	26802.	7166.	103.	18875.	0.
1943	5	80000.	80000.	18017.	7166.	261.	10590.	0.
1943	6	80000.	80000.	15634.	7166.	326.	8143.	0.
1943	7	80000.	77838.	5427.	7166.	423.	0.	0.
1943	8	80000.	71558.	1206.	7166.	320.	0.	0.
1943	9	80000.	64992.	722.	7166.	122.	0.	0.
1943	10	80000.	62622.	1325.	3580.	116.	0.	0.
1943	11	80000.	60048.	1050.	3580.	44.	0.	0.
1943	12	80000.	56898.	469.	3580.	40.	0.	0.
1944	1	80000.	53425.	149.	3580.	41.	0.	0.
1944	2	80000.	49954.	149.	3580.	40.	0.	0.
1944	3	80000.	47006.	670.	3580.	38.	0.	0.
1944	4	80000.	45795.	6030.	7166.	76.	0.	0.
1944	5	80000.	41866.	3425.	7166.	188.	0.	0.
1944	6	80000.	38349.	3871.	7166.	222.	0.	0.
1944	7	80000.	32770.	1861.	7166.	274.	0.	0.
1944	8	80000.	26008.	596.	7166.	192.	0.	0.
1944	9	80000.	19147.	372.	7166.	67.	0.	0.
1944	10	80000.	16181.	670.	3580.	56.	0.	0.
1944	11	80000.	13177.	596.	3580.	20.	0.	0.
1944	12	80000.	9804.	223.	3580.	16.	0.	0.
1945	1	80000.	6284.	74.	3580.	15.	0.	0.
1945	2	80000.	2768.	74.	3580.	11.	0.	0.
1945	3	80000.	670.	1489.	3580.	7.	0.	0.
1945	4	80000.	0.	2755.	7166.	6.	0.	3748.
1945	5	80000.	13978.	21144.	7166.	0.	0.	0.
1945	6	80000.	45558.	38863.	7166.	116.	0.	0.
1945	7	80000.	49331.	11242.	7166.	304.	0.	0.
1945	8	80000.	43930.	2010.	7166.	245.	0.	0.
1945	9	80000.	39129.	2457.	7166.	92.	0.	0.
1945	10	80000.	38516.	3052.	3580.	86.	0.	0.
1945	11	80000.	36467.	1563.	3580.	33.	0.	0.
1945	12	80000.	35166.	2308.	3580.	29.	0.	0.
1946	1	80000.	32523.	968.	3580.	31.	0.	0.
1946	2	80000.	30030.	1117.	3580.	30.	0.	0.
1946	3	80000.	30219.	3797.	3580.	28.	0.	0.
1946	4	80000.	28355.	5360.	7166.	58.	0.	0.
1946	5	80000.	29609.	8562.	7166.	142.	0.	0.
1946	6	80000.	48245.	25983.	7166.	181.	0.	0.
1946	7	80000.	46647.	5882.	7166.	314.	0.	0.
1946	8	80000.	41254.	2010.	7166.	237.	0.	0.
1946	9	80000.	38913.	4914.	7166.	88.	0.	0.

1948	12	80000.	33771.	1266.	3580.	32.	0.	0.
1947	1	80000.	33645.	1266.	3580.	32.	0.	0.
1947	2	80000.	33460.	3425.	3580.	30.	0.	0.
1947	3	80000.	39156.	9306.	3580.	30.	0.	0.
1947	4	80000.	55151.	23228.	7166.	68.	0.	0.
1947	5	80000.	74354.	26579.	7166.	210.	0.	0.
1947	6	80000.	80000.	24568.	7166.	312.	11444.	0.
1947	7	80000.	79409.	6998.	7166.	423.	0.	0.
1947	8	80000.	77428.	5509.	7166.	324.	0.	0.
1947	9	80000.	80000.	11093.	7166.	128.	1227.	0.
1947	10	80000.	80000.	8636.	3580.	131.	4926.	0.
1947	11	80000.	80000.	5286.	3580.	51.	1655.	0.
1947	12	80000.	80000.	4020.	3580.	47.	394.	0.
1948	1	80000.	79124.	2755.	3580.	51.	0.	0.
1948	2	80000.	77653.	2159.	3580.	50.	0.	0.
1948	3	80000.	80000.	10274.	3580.	50.	4298.	0.
1948	4	80000.	80000.	35810.	7166.	103.	28541.	0.
1948	5	80000.	80000.	94998.	7166.	261.	87571.	0.
1948	6	80000.	80000.	65814.	7166.	326.	58322.	0.
1948	7	80000.	80000.	22261.	7166.	423.	14671.	0.
1948	8	80000.	80000.	10051.	7166.	326.	2559.	0.
1948	9	80000.	76947.	4244.	7166.	131.	0.	0.
1948	10	80000.	76515.	3276.	3580.	128.	0.	0.
1948	11	80000.	74971.	2085.	3580.	49.	0.	0.
1948	12	80000.	72016.	670.	3580.	45.	0.	0.
1949	1	80000.	68761.	372.	3580.	48.	0.	0.
1949	2	80000.	65358.	223.	3580.	46.	0.	0.
1949	3	80000.	63148.	1415.	3580.	45.	0.	0.
1949	4	80000.	65645.	9753.	7166.	90.	0.	0.
1949	5	80000.	68074.	9827.	7166.	233.	0.	0.
1949	6	80000.	69546.	8934.	7166.	296.	0.	0.
1949	7	80000.	64671.	2680.	7166.	390.	0.	0.
1949	8	80000.	57515.	298.	7166.	287.	0.	0.
1949	9	80000.	50614.	372.	7166.	108.	0.	0.
1949	10	80000.	47977.	1042.	3580.	100.	0.	0.
1949	11	80000.	45774.	1415.	3580.	37.	0.	0.
1949	12	80000.	42756.	596.	3580.	34.	0.	0.
1950	1	80000.	39290.	149.	3580.	35.	0.	0.
1950	2	80000.	36719.	1042.	3580.	33.	0.	0.
1950	3	80000.	36160.	3052.	3580.	32.	0.	0.
1950	4	80000.	37938.	9008.	7166.	65.	0.	0.
1950	5	80000.	44749.	14145.	7166.	168.	0.	0.
1950	6	80000.	47477.	10125.	7166.	231.	0.	0.
1950	7	80000.	42606.	2606.	7166.	311.	0.	0.
1950	8	80000.	36630.	1415.	7166.	225.	0.	0.
1950	9	80000.	29754.	372.	7166.	82.	0.	0.
1950	10	80000.	27069.	968.	3580.	73.	0.	0.
1950	11	80000.	24058.	596.	3580.	27.	0.	0.
1950	12	80000.	21051.	596.	3580.	23.	0.	0.
1951	1	80000.	17895.	447.	3580.	23.	0.	0.
1951	2	80000.	14667.	372.	3580.	21.	0.	0.
1951	3	80000.	31691.	20623.	3580.	19.	0.	0.
1951	4	80000.	41142.	16677.	7166.	60.	0.	0.
1951	5	80000.	75566.	41766.	7166.	177.	0.	0.
1951	6	80000.	80000.	83012.	7166.	315.	71097.	0.
1951	7	80000.	80000.	35066.	7166.	423.	27477.	0.
1951	8	80000.	80000.	16602.	7166.	326.	9111.	0.
1951	9	80000.	80000.	34470.	7166.	131.	27174.	0.
1951	10	80000.	80000.	22856.	3580.	131.	19146.	0.
1951	11	80000.	80000.	9976.	3580.	51.	6346.	0.
1951	12	80000.	80000.	6105.	3580.	47.	2478.	0.
1952	1	80000.	77784.	1415.	3580.	51.	0.	0.
1952	2	80000.	78621.	4467.	3580.	50.	0.	0.
1952	3	80000.	80000.	12359.	3580.	50.	7350.	0.

1952	6	80000.	80000.	24122.	7166.	326.	16630.	0.
1952	7	80000.	80000.	14145.	7166.	423.	6556.	0.
1952	8	80000.	80000.	9455.	7166.	326.	1964.	0.
1952	9	80000.	77394.	4690.	7166.	131.	0.	0.
1952	10	80000.	76813.	3127.	3580.	128.	0.	0.
1952	11	80000.	75343.	2159.	3580.	50.	0.	0.
1952	12	80000.	72983.	1266.	3580.	45.	0.	0.
1953	1	80000.	70174.	819.	3580.	48.	0.	0.
1953	2	80000.	68037.	1489.	3580.	47.	0.	0.
1953	3	80000.	72973.	8562.	3580.	46.	0.	0.
1953	4	80000.	80000.	17496.	7166.	98.	3205.	0.
1953	5	80000.	80000.	55391.	7166.	261.	47964.	0.
1953	6	80000.	80000.	163269.	7166.	326.	155777.	0.
1953	7	80000.	80000.	29482.	7166.	423.	21893.	0.
1953	8	80000.	80000.	8860.	7166.	326.	1368.	0.
1953	9	80000.	77692.	4988.	7166.	131.	0.	0.
1953	10	80000.	77334.	3350.	3580.	128.	0.	0.
1953	11	80000.	76608.	2904.	3580.	50.	0.	0.
1953	12	80000.	74918.	1936.	3580.	46.	0.	0.
1954	1	80000.	73002.	1712.	3580.	49.	0.	0.
1954	2	80000.	72054.	2680.	3580.	48.	0.	0.
1954	3	80000.	70437.	2010.	3580.	48.	0.	0.
1954	4	80000.	76948.	13773.	7166.	96.	0.	0.
1954	5	80000.	80000.	35885.	7166.	255.	25412.	0.
1954	6	80000.	80000.	24047.	7166.	326.	16556.	0.
1954	7	80000.	78665.	6254.	7166.	423.	0.	0.
1954	8	80000.	77281.	6105.	7166.	322.	0.	0.
1954	9	80000.	77060.	7073.	7166.	128.	0.	0.
1954	10	80000.	80000.	9455.	3580.	128.	2808.	0.
1954	11	80000.	80000.	5360.	3580.	51.	1730.	0.
1954	12	80000.	78905.	2531.	3580.	47.	0.	0.
1955	1	80000.	76243.	968.	3580.	50.	0.	0.
1955	2	80000.	74177.	1563.	3580.	49.	0.	0.
1955	3	80000.	72410.	1861.	3580.	48.	0.	0.
1955	4	80000.	80000.	29854.	7166.	97.	15001.	0.
1955	5	80000.	80000.	62538.	7166.	261.	55111.	0.
1955	6	80000.	80000.	34694.	7166.	326.	27202.	0.
1955	7	80000.	80000.	29706.	7166.	423.	22116.	0.
1955	8	80000.	78241.	5733.	7166.	326.	0.	0.
1955	9	80000.	74371.	3425.	7166.	129.	0.	0.
1955	10	80000.	73867.	3201.	3580.	125.	0.	0.
1955	11	80000.	71579.	1340.	3580.	48.	0.	0.
1955	12	80000.	69668.	1712.	3580.	44.	0.	0.
1956	1	80000.	67456.	1415.	3580.	47.	0.	0.
1956	2	80000.	64649.	819.	3580.	46.	0.	0.
1956	3	80000.	68247.	7222.	3580.	45.	0.	0.
1956	4	80000.	71409.	10423.	7166.	94.	0.	0.
1956	5	80000.	80000.	18612.	7166.	244.	2612.	0.
1956	6	80000.	80000.	8189.	7166.	326.	698.	0.
1956	7	80000.	80000.	14816.	7166.	423.	7226.	0.
1956	8	80000.	75486.	2978.	7166.	326.	0.	0.
1956	9	80000.	70428.	2233.	7166.	126.	0.	0.
1956	10	80000.	68514.	1787.	3580.	121.	0.	0.
1956	11	80000.	66749.	1861.	3580.	46.	0.	0.
1956	12	80000.	64095.	968.	3580.	42.	0.	0.
1957	1	80000.	60843.	372.	3580.	44.	0.	0.
1957	2	80000.	58411.	1191.	3580.	43.	0.	0.
1957	3	80000.	58958.	4169.	3580.	42.	0.	0.
1957	4	80000.	65479.	13773.	7166.	86.	0.	0.
1957	5	80000.	80000.	23079.	7166.	232.	1161.	0.
1957	6	80000.	80000.	15411.	7166.	326.	7920.	0.
1957	7	80000.	75538.	3127.	7166.	423.	0.	0.
1957	8	80000.	69620.	1563.	7166.	315.	0.	0.
1957	9	80000.	63823.	1489.	7166.	120.	0.	0.

1958	1	80000.	56187.	744.	3580.	42.	0.	0.
1958	2	80000.	53385.	819.	3580.	41.	0.	0.
1958	3	80000.	53637.	3871.	3580.	40.	0.	0.
1958	4	80000.	74085.	27695.	7166.	82.	0.	0.
1958	5	80000.	80000.	29482.	7166.	250.	16151.	0.
1958	6	80000.	80000.	19506.	7166.	326.	12014.	0.
1958	7	80000.	80000.	26504.	7166.	423.	18915.	0.
1958	8	80000.	80000.	8189.	7166.	326.	698.	0.
1958	9	80000.	76054.	3350.	7166.	131.	0.	0.
1958	10	80000.	74208.	1861.	3580.	127.	0.	0.
1958	11	80000.	72367.	1787.	3580.	49.	0.	0.
1958	12	80000.	70306.	1563.	3580.	44.	0.	0.
1959	1	80000.	67722.	1042.	3580.	47.	0.	0.
1959	2	80000.	64841.	744.	3580.	46.	0.	0.
1959	3	80000.	72086.	10870.	3580.	45.	0.	0.
1959	4	80000.	77703.	12880.	7166.	97.	0.	0.
1959	5	80000.	80000.	25164.	7166.	257.	15444.	0.
1959	6	80000.	80000.	19431.	7166.	326.	11940.	0.
1959	7	80000.	77995.	5584.	7166.	423.	0.	0.
1959	8	80000.	73039.	2531.	7166.	321.	0.	0.
1959	9	80000.	68578.	2829.	7166.	124.	0.	0.
1959	10	80000.	67336.	2457.	3580.	119.	0.	0.
1959	11	80000.	66614.	2904.	3580.	46.	0.	0.
1959	12	80000.	65003.	2010.	3580.	42.	0.	0.
1960	1	80000.	62941.	1563.	3580.	45.	0.	0.
1960	2	80000.	61923.	2606.	3580.	44.	0.	0.
1960	3	80000.	73339.	15039.	3580.	44.	0.	0.
1960	4	80000.	73818.	7743.	7166.	98.	0.	0.
1960	5	80000.	80000.	22558.	7166.	249.	8961.	0.
1960	6	80000.	80000.	10274.	7166.	326.	2782.	0.
1960	7	80000.	74272.	1861.	7166.	423.	0.	0.
1960	8	80000.	68135.	1340.	7166.	312.	0.	0.
1960	9	80000.	61296.	447.	7166.	119.	0.	0.
1960	10	80000.	58350.	744.	3580.	112.	0.	0.
1960	11	80000.	55323.	596.	3580.	42.	0.	0.
1960	12	80000.	52227.	521.	3580.	38.	0.	0.
1961	1	80000.	49278.	670.	3580.	39.	0.	0.
1961	2	80000.	46330.	670.	3580.	38.	0.	0.
1961	3	80000.	44203.	1489.	3580.	37.	0.	0.
1961	4	80000.	40240.	3276.	7166.	73.	0.	0.
1961	5	80000.	45556.	12656.	7166.	174.	0.	0.
1961	6	80000.	43070.	4914.	7166.	234.	0.	0.
1961	7	80000.	36653.	1042.	7166.	294.	0.	0.
1961	8	80000.	30398.	1117.	7166.	205.	0.	0.
1961	9	80000.	23903.	744.	7166.	74.	0.	0.
1961	10	80000.	23684.	3425.	3580.	64.	0.	0.
1961	11	80000.	22313.	2233.	3580.	25.	0.	0.
1961	12	80000.	19828.	1117.	3580.	22.	0.	0.
1962	1	80000.	18534.	2308.	3580.	22.	0.	0.
1962	2	80000.	18581.	3648.	3580.	21.	0.	0.
1962	3	80000.	26742.	11763.	3580.	21.	0.	0.
1962	4	80000.	44612.	25090.	7166.	54.	0.	0.
1962	5	80000.	47386.	10125.	7166.	185.	0.	0.
1962	6	80000.	46682.	6700.	7166.	239.	0.	0.
1962	7	80000.	41069.	1861.	7166.	308.	0.	0.
1962	8	80000.	34279.	596.	7166.	220.	0.	0.
1962	9	80000.	27778.	744.	7166.	79.	0.	0.
1962	10	80000.	24873.	744.	3580.	70.	0.	0.
1962	11	80000.	21938.	670.	3580.	25.	0.	0.
1962	12	80000.	18783.	447.	3580.	22.	0.	0.
1963	1	80000.	15628.	447.	3580.	22.	0.	0.
1963	2	80000.	13071.	1042.	3580.	19.	0.	0.
1963	3	80000.	10591.	1117.	3580.	17.	0.	0.
1963	4	80000.	5478.	2085.	7166.	71.	0.	0.

[illegible]	6	80000.	[illegible]	36927.	7166.	49.	0.	0.
1963	7	80000.	63214.	37672.	7166.	251.	0.	0.
1963	8	80000.	59040.	3276.	7166.	283.	0.	0.
1963	9	80000.	53552.	1787.	7166.	109.	0.	0.
1963	10	80000.	51209.	1340.	3580.	103.	0.	0.
1963	11	80000.	48484.	893.	3580.	39.	0.	0.
1963	12	80000.	45614.	744.	3580.	35.	0.	0.
1964	1	80000.	42295.	298.	3580.	36.	0.	0.
1964	2	80000.	38979.	298.	3580.	35.	0.	0.
1964	3	80000.	35738.	372.	3580.	33.	0.	0.
1964	4	80000.	34464.	5956.	7166.	64.	0.	0.
1964	5	80000.	63396.	36257.	7166.	159.	0.	0.
1964	6	80000.	77909.	21963.	7166.	284.	0.	0.
1964	7	80000.	76654.	6328.	7166.	417.	0.	0.
1964	8	80000.	70734.	1563.	7166.	318.	0.	0.
1964	9	80000.	65829.	2382.	7166.	122.	0.	0.
1964	10	80000.	63920.	1787.	3580.	116.	0.	0.
1964	11	80000.	61561.	1266.	3580.	44.	0.	0.
1964	12	80000.	58537.	596.	3580.	40.	0.	0.
1965	1	80000.	55287.	372.	3580.	42.	0.	0.
1965	2	80000.	55538.	3871.	3580.	41.	0.	0.
1965	3	80000.	53109.	1191.	3580.	41.	0.	0.
1965	4	80000.	63730.	17868.	7166.	81.	0.	0.
1965	5	80000.	66163.	9827.	7166.	229.	0.	0.
1965	6	80000.	80000.	25685.	7166.	291.	4391.	0.
1965	7	80000.	80000.	19729.	7166.	423.	12140.	0.
1965	8	80000.	77124.	4616.	7166.	326.	0.	0.
1965	9	80000.	76829.	6998.	7166.	128.	0.	0.
1965	10	80000.	77812.	4690.	3580.	128.	0.	0.
1965	11	80000.	76639.	2457.	3580.	50.	0.	0.
1965	12	80000.	74800.	1787.	3580.	46.	0.	0.
1966	1	80000.	71916.	744.	3580.	49.	0.	0.
1966	2	80000.	69182.	893.	3580.	48.	0.	0.
1966	3	80000.	72778.	7222.	3580.	47.	0.	0.
1966	4	80000.	72885.	7371.	7166.	98.	0.	0.
1966	5	80000.	79468.	13997.	7166.	247.	0.	0.
1966	6	80000.	80000.	32162.	7166.	324.	24140.	0.
1966	7	80000.	79707.	7296.	7166.	423.	0.	0.
1966	8	80000.	76460.	4244.	7166.	325.	0.	0.
1966	9	80000.	70879.	1712.	7166.	127.	0.	0.
1966	10	80000.	69262.	2085.	3580.	122.	0.	0.
1966	11	80000.	67348.	1712.	3580.	47.	0.	0.
1966	12	80000.	64471.	744.	3580.	42.	0.	0.
1967	1	80000.	61144.	298.	3580.	45.	0.	0.
1967	2	80000.	58117.	596.	3580.	43.	0.	0.
1967	3	80000.	63652.	9157.	3580.	42.	0.	0.
1967	4	80000.	65032.	8636.	7166.	90.	0.	0.
1967	5	80000.	80000.	62761.	7166.	231.	40396.	0.
1967	6	80000.	80000.	80257.	7166.	326.	72765.	0.
1967	7	80000.	80000.	13252.	7166.	423.	5663.	0.
1967	8	80000.	76231.	3722.	7166.	326.	0.	0.
1967	9	80000.	69980.	1042.	7166.	127.	0.	0.
1967	10	80000.	67396.	1117.	3580.	121.	0.	0.
1967	11	80000.	65037.	1266.	3580.	46.	0.	0.
1967	12	80000.	61862.	447.	3580.	41.	0.	0.
1968	1	80000.	58909.	670.	3580.	44.	0.	0.
1968	2	80000.	55957.	670.	3580.	42.	0.	0.
1968	3	80000.	55314.	2978.	3580.	41.	0.	0.
1968	4	80000.	51192.	3127.	7166.	83.	0.	0.
1968	5	80000.	50079.	6254.	7166.	201.	0.	0.
1968	6	80000.	54727.	12061.	7166.	247.	0.	0.
1968	7	80000.	52062.	4839.	7166.	338.	0.	0.
1968	8	80000.	48068.	3425.	7166.	253.	0.	0.
1968	9	80000.	48101.	7296.	7166.	97.	0.	0.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

1968	12	80000.	49127.	2381.	3580.	38.	0.	0.
1969	1	80000.	53221.	1712.	3580.	41.	0.	0.
1969	2	80000.	51015.	1415.	3580.	40.	0.	0.
1969	3	80000.	56629.	9232.	3580.	39.	0.	0.
1969	4	80000.	80000.	40203.	7166.	84.	9581.	0.
1969	5	80000.	80000.	31418.	7166.	261.	23991.	0.
1969	6	80000.	80000.	51222.	7166.	326.	43730.	0.
1969	7	80000.	80000.	64771.	7166.	423.	57182.	0.
1969	8	80000.	79283.	6775.	7166.	326.	0.	0.
1969	9	80000.	75040.	3052.	7166.	130.	0.	0.
1969	10	80000.	74312.	2978.	3580.	126.	0.	0.
1969	11	80000.	73439.	2755.	3580.	49.	0.	0.
1969	12	80000.	70931.	1117.	3580.	44.	0.	0.
1970	1	80000.	68793.	1489.	3580.	47.	0.	0.
1970	2	80000.	67177.	2010.	3580.	46.	0.	0.
1970	3	80000.	67646.	4095.	3580.	46.	0.	0.
1970	4	80000.	69842.	9455.	7166.	94.	0.	0.
1970	5	80000.	80000.	23079.	7166.	241.	5514.	0.
1970	6	80000.	80000.	29557.	7166.	326.	22065.	0.
1970	7	80000.	80000.	8041.	7166.	423.	451.	0.
1970	8	80000.	73923.	1415.	7166.	326.	0.	0.
1970	9	80000.	67898.	1266.	7166.	125.	0.	0.
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1970	12	80000.	60230.	744.	3580.	41.	0.	0.
1971	1	80000.	60627.	4020.	3580.	43.	0.	0.
1971	2	80000.	65417.	8413.	3580.	43.	0.	0.
1971	3	80000.	67749.	5956.	3580.	45.	0.	0.
1971	4	80000.	76347.	15858.	7166.	94.	0.	0.
1971	5	80000.	80000.	11763.	7166.	254.	690.	0.
1971	6	80000.	80000.	17942.	7166.	326.	10451.	0.
1971	7	80000.	75314.	2904.	7166.	423.	0.	0.
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1971	9	80000.	61443.	744.	7166.	119.	0.	0.
1971	10	80000.	59315.	1563.	3580.	112.	0.	0.
1971	11	80000.	56660.	968.	3580.	42.	0.	0.
1971	12	80000.	53117.	74.	3580.	38.	0.	0.
1972	1	80000.	49646.	149.	3580.	40.	0.	0.
1972	2	80000.	46773.	744.	3580.	38.	0.	0.
1972	3	80000.	60577.	17421.	3580.	37.	0.	0.
1972	4	80000.	78041.	24717.	7166.	88.	0.	0.
1972	5	80000.	80000.	44670.	7166.	258.	35288.	0.
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1972	8	80000.	80000.	9604.	7166.	322.	483.	0.
1972	9	80000.	78659.	5956.	7166.	131.	0.	0.
1972	10	80000.	80000.	5137.	3580.	129.	87.	0.
1972	11	80000.	80000.	4318.	3580.	51.	688.	0.
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1973	2	80000.	77601.	3499.	3580.	50.	0.	0.
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1973	4	80000.	80000.	13252.	7166.	103.	5539.	0.
1973	5	80000.	80000.	30301.	7166.	261.	22874.	0.
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1973	10	80000.	63771.	1712.	3580.	116.	0.	0.
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1973	12	80000.	58909.	1191.	3580.	40.	0.	0.
1974	1	80000.	56180.	893.	3580.	42.	0.	0.
1974	2	80000.	53900.	1340.	3580.	41.	0.	0.
1974	3	80000.	58469.	8189.	3580.	40.	0.	0.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24522.	0.
1974	7	80000.	78516.	6105.	7166.	423.	0.	0.
1974	8	80000.	75495.	4467.	7166.	322.	0.	0.
1974	9	80000.	71553.	3350.	7166.	126.	0.	0.
1974	10	80000.	70754.	2904.	3580.	122.	0.	0.
1974	11	80000.	69063.	1936.	3580.	47.	0.	0.
1974	12	80000.	67078.	1638.	3580.	43.	0.	0.
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1975	8	80000.	79134.	6626.	7166.	326.	0.	0.
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1975	10	80000.	73866.	2755.	3580.	126.	0.	0.
1975	11	80000.	71801.	1563.	3580.	48.	0.	0.
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1976	2	80000.	65913.	1042.	3580.	46.	0.	0.
1976	3	80000.	70850.	8562.	3580.	45.	0.	0.
1976	4	80000.	73936.	10349.	7166.	96.	0.	0.
1976	5	80000.	79773.	13252.	7166.	249.	0.	0.
1976	6	80000.	79429.	7147.	7166.	325.	0.	0.
1976	7	80000.	73852.	2010.	7166.	421.	0.	0.
1976	8	80000.	80000.	23154.	7166.	311.	9529.	0.
1976	9	80000.	76054.	3350.	7166.	131.	0.	0.
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1977	3	80000.	63078.	1936.	3580.	45.	0.	0.
1977	4	80000.	61033.	5211.	7166.	90.	0.	0.
1977	5	80000.	56623.	2978.	7166.	223.	0.	0.
1977	6	80000.	50308.	1117.	7166.	266.	0.	0.
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1977	8	80000.	36471.	1042.	7166.	225.	0.	0.
1977	9	80000.	30265.	1042.	7166.	82.	0.	0.
1977	10	80000.	27803.	1191.	3580.	74.	0.	0.
1977	11	80000.	24345.	149.	3580.	27.	0.	0.
1977	12	80000.	21040.	298.	3580.	23.	0.	0.
1978	1	80000.	17586.	149.	3580.	23.	0.	0.
1978	2	80000.	14388.	402.	3580.	21.	0.	0.
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1978	5	80000.	48925.	33875.	7166.	123.	0.	0.
1978	6	80000.	68243.	26728.	7166.	244.	0.	0.
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1978	8	80000.	73611.	5733.	7166.	314.	0.	0.
1978	9	80000.	71308.	4988.	7166.	124.	0.	0.
1978	10	80000.	70212.	2606.	3580.	122.	0.	0.
1978	11	80000.	68968.	2382.	3580.	47.	0.	0.
1978	12	80000.	66537.	1191.	3580.	43.	0.	0.

NUMBER OF YEARS OF RESERVOIR DEPLETION = 5

MBER OF YEARS OF SPILL = 41

DATA FILE

60000. 20000.
1.00
1912
2 67

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6.3	13.5	31.1	140.	142.	129.	88.7	21.2	16.2	79.1	42.7	25.2
6.7	16.6	43.1	103.	775.	1100.	776.	421.	200.	112.	55.7	42.1
6.6	32.6	103.	168.	275.	873.	391.	128.	162.	140.	70.0	47.5
7.8	15.8	43.4	299.	1035.	1256.	267.	117.	71.4	55.6	42.7	13.5
6.7	16.8	54.2	81.5	137.	99.9	24.4	15.5	27.0	27.3	12.4	4.2
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3.5	0.92	4.4	171.	322.	140.	63.0	14.8	6.0	11.1	8.6	2.3
4.1	0.92	10.3	77.1	120.	1485.	434.	205.	78.4	49.3	30.0	16.2
6.1	12.2	47.9	96.7	220.	552.	107.	187.	31.9	28.4	19.9	9.7
5.6	8.5	94.5	160.	216.	385.	64.8	35.7	63.4	78.0	42.3	24.9
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7.7	27.8	61.5	108.	501.	758.	235.	425.	511.	311.	118.	90.0
8.5	40.3	329.	166.	257.	412.	514.	64.1	74.6	63.9	36.4	20.7
6.4	14.4	76.7	119.	403.	1416.	65.1	14.3	11.1	18.7	14.3	6.6
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5.4	7.5	19.3	123.	112.	78.3	5.4	2.9	1.4	2.4	3.2	0.99
3.6	1.7	1.8	45.6	66.6	156.	24.8	15.7	13.9	36.4	24.0	12.3
5.8	10.0	30.8	106.	593.	352.	126.	14.5	14.0	16.3	13.2	5.8
5.1	5.9	63.0	59.1	19.4	320.	70.9	44.8	14.0	24.4	17.8	8.4
5.4	7.7	18.2	133.	262.	134.	40.9	14.5	20.2	45.6	28.4	15.1
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6.5	15.2	22.9	121.	1069.	1105.	472.	249.	166.	113.	55.7	35.1
7.1	20.9	123.	360.	242.	210.	72.9	16.2	9.7	17.8	14.1	6.3
2.0	2.0	9.0	81.0	46.0	52.0	25.0	8.0	5.0	9.0	8.0	3.0
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13.0	15.0	51.0	72.0	115.	349.	79.0	27.0	66.0	54.0	32.0	21.0
17.0	46.0	125.	312.	357.	330.	94.0	74.0	149.	116.	71.0	54.0
37.0	29.0	138.	481.	1276.	884.	299.	135.	57.0	44.0	28.0	9.0
5.0	3.0	19.0	131.	132.	120.	36.0	4.0	5.0	14.0	19.0	8.0
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6.0	5.0	277.	224.	561.	1115.	471.	223.	463.	307.	134.	82.0
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19.0	11.0	97.0	140.	250.	110.	199.	40.0	30.0	24.0	25.0	13.0
5.0	16.0	56.0	185.	310.	207.	42.0	21.0	20.0	35.0	31.0	17.0
10.0	11.0	52.0	372.	396.	262.	356.	110.	45.0	25.0	24.0	21.0
14.0	10.0	146.	173.	338.	261.	75.0	34.0	38.0	33.0	39.0	27.0
21.0	35.0	202.	104.	303.	138.	25.0	18.0	6.0	10.0	8.0	7.0
9.0	9.0	20.0	44.0	170.	66.0	14.0	15.0	10.0	46.0	30.0	15.0
31.0	49.0	158.	337.	136.	90.0	25.0	8.0	10.0	10.0	9.0	5.0
6.0	14.0	15.0	28.0	67.0	496.	506.	44.0	24.0	18.0	12.0	10.0
4.0	4.0	5.0	80.0	487.	295.	85.0	21.0	32.0	24.0	17.0	8.0
5.0	52.0	16.0	240.	132.	345.	265.	62.0	94.0	63.0	33.0	24.0
10.0	12.0	97.0	99.0	188.	432.	98.0	57.0	23.0	38.0	23.0	16.0
4.0	8.0	123.	116.	843.	1078.	178.	50.0	14.0	15.0	17.0	6.0
9.0	9.0	40.0	42.0	84.0	162.	65.0	46.0	99.0	149.	58.0	34.0

```
54.0   113.   80.0   213.   158.   241.   39.0    2.0   10.0   21.0   13.0    1.0
 2.0    10.0  234.   332.   600.   283.   80.0   129.   80.0   69.0   58.0   27.0
40.0    47.0  75.0   178.   407.   255.   57.0   28.0   24.0   23.0   16.0   16.0
12.0    18.0  110.   216.   775.   430.   82.0   60.0   45.0   39.0   26.0   22.0
15.0    25.0  51.0   286.   629.   588.   247.   89.0   40.0   37.0   21.0   17.0
56.0    14.0  115.   139.   178.   96.0   27.0   311.   45.0   29.0   15.0   19.0
23.0     7.0  26.0   70.0   40.0   15.0    0.0   14.0   14.0   16.0    2.0    4.0
 2.0     5.4  124.   128.   435.   359.   197.   77.0   67.0   35.0   32.0   16.0
   74.45
  64500.
.0555 .0555 .0555 .1111 .1111 .1111 .1111 .1111 .1111 .0555 .0555 .0555
    300.
026 0.026 0.026 0.053 0.134 0.167 0.217 0.167 0.067 0.067 0.026 0.024
   0.832       0.59
       1
```

K,

APPENDIX IV

PROGRESS REPORT ON FINAL SITE SELECTION
DATED MARCH 19, 1984

Note:

The selected sites identified in this progress report have been re-numbered as follows:

New Site Numbers	Site Numbers per Progress Report
1	20D
2	3
3	15B
4	11
5	12
6	34

KLOHN LEONOFF
CONSULTING ENGINEERS

OUR FILE: PA 1956.101

March 19, 1984

Alberta Environment
Provincial Building
200-5th Avenue S
Lethbridge, Alberta
T1J 4C7

Mr. L.K. Szojka, P. Eng.
Oldman River Basin Planner

Willow Creek Basin - Inventory of Storage Sites
Progress Report

Dear Mr. Szojka:

Please find enclosed a point form set of notes which summarize our reasons for selecting the final six sites from the 14 sites identified at our meeting on March 8, 1984.

We discussed the selection of these sites with Mr. S. Larson on March 15, 1984 by telephone as being the six most promising sites. The final selection was based on the site reconnaissance carried out on March 9, 1984 and on a detailed review of the air photographs. We have attached a 1:250,000 map of the Willow Creek Basin indicating the locations of the six sites.

Having completed site selection, we are presently carrying out conceptual design and costing of the final six selected schemes.

Yours very truly,

KLOHN LEONOFF LTD.

For/ DONALD R. PETTEY, P. Eng.
Project Manager

LFS/pmb
Enc.

LIST OF POTENTIAL RESERVIOIR SITES SELECTED AT MEETING ON MARCH 8, 1984

SITE	CREEK NAME
2	Stavely
3	Pine
9	Willow above Chain Lakes
11	Willow
12	South Willow
13	South Willow
14	South Willow
15	Willow
16	Willow
20	Willow
31	Burke/Trout
33	Trout
36	Kayiskap
37	Langford/Chaffen

FINAL SITES SELECTED FOR DETAILED COMPARISON

SITE	CREEK NAME
3	Pine Coulee
11	Willow Creek
12	South Willow Creek
15B	Willow Creek
20D	Willow Creek
34	Trout Creek

RATIONAL FOR FINAL SITE SELECTION

Site 3 - Willow Creek/Pine Coulee

This site was selected as it has the apparent advantage of significant storage capability and does not require a significant dam on Willow Creek. Only a low diversion dyke would likely be required to divert water into Pine Coulee. Preliminary computations indicate that this site would provide a relatively good ratio of reservoir volume to dam volume.

This site was identified and studied in some detail by the PFRA in the 1950's.

Site 11 - Willow Creek Above Confluence with South Willow Creek

This site was selected because preliminary computations indicate that it would provide an excellent ratio of reservoir volume to dam volume. The main dam would be located in a relatively narrow rock gorge.

Site 12 - South Willow Creek

This site was selected because it appeared to provide the best potential on South Willow Creek. Site 13, the only other potential damsite identified on South Willow Creek, would be less preferrable because of potentially poor foundation conditions on the left abutment.

Site 15B - Willow Creek Above Pine Coulee

This site is several kilometers upstream of the original site 15 and was identified during the field reconnaisance on March 9, 1984. It was selected as being the most promising of Sites 14, 15, 15A, 16 and 16b all within a 12 km of each other on Willow Creek, above the confluence with Pine Coulee (15A and 16B were also identified during the field reconnaissance). Nevertheless Sites 16, 16B and 15 are

believed to have good potential but Site 14 was found to have poor potential because of pervious soils on the left abutment. Damsite 15B is at a relatively narrow deep rock gorge with rock outcrops on both sides to approximatly 3/4 of the dam height. A spillway location was also identified on the left abutment.

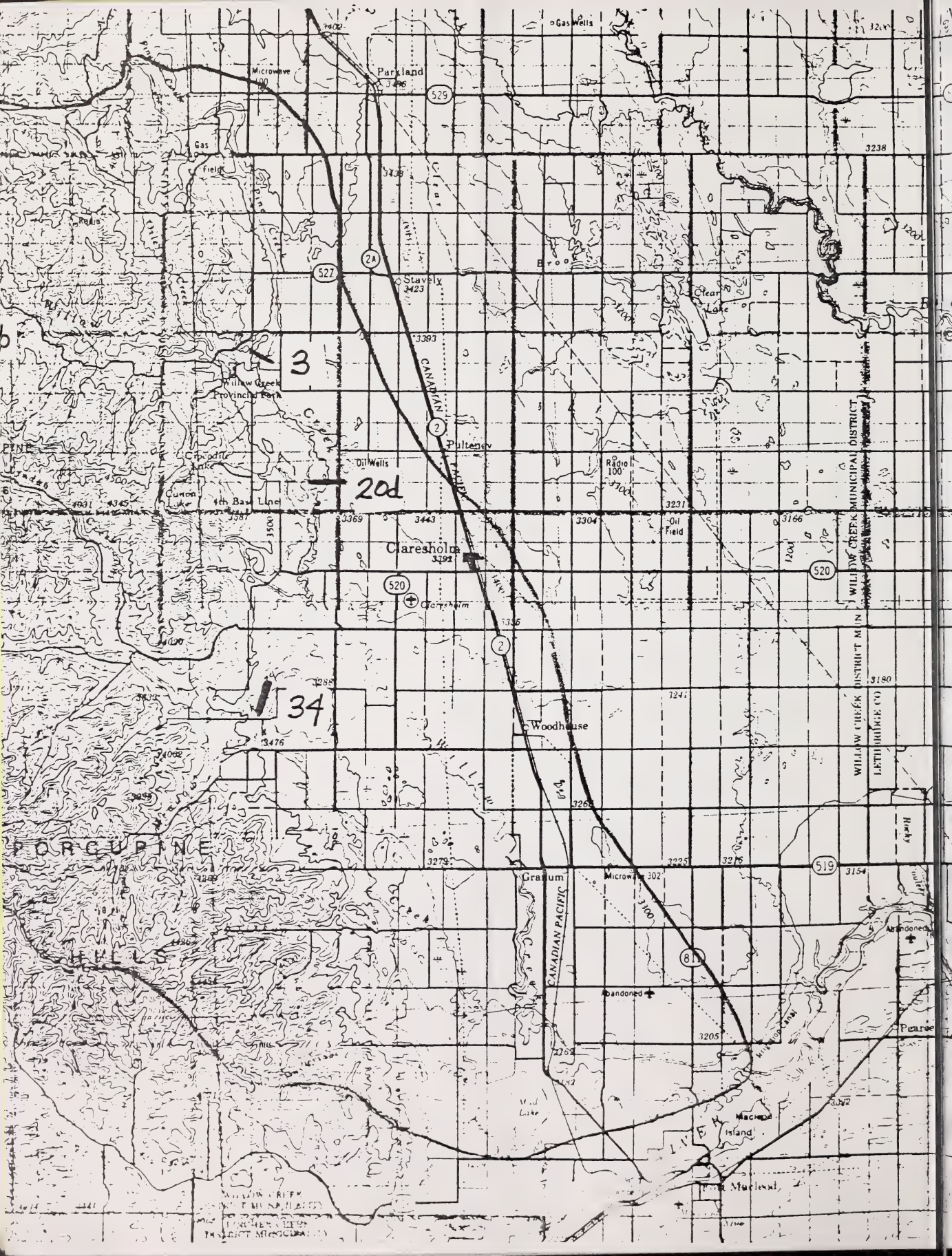
Site 20D - Willow Creek Above Claresholm

Several other Sites, 20B, 20C and 20D, all within several kilometers of Site 20 were identified during the reconnaissance. Site 20D was considered to be the most promising of these and was selected for the detailed comparison because of it's location on the lower reach of Willow Creek near the towns of Claresholm and Stavely.

Site 34 - Trout Creek

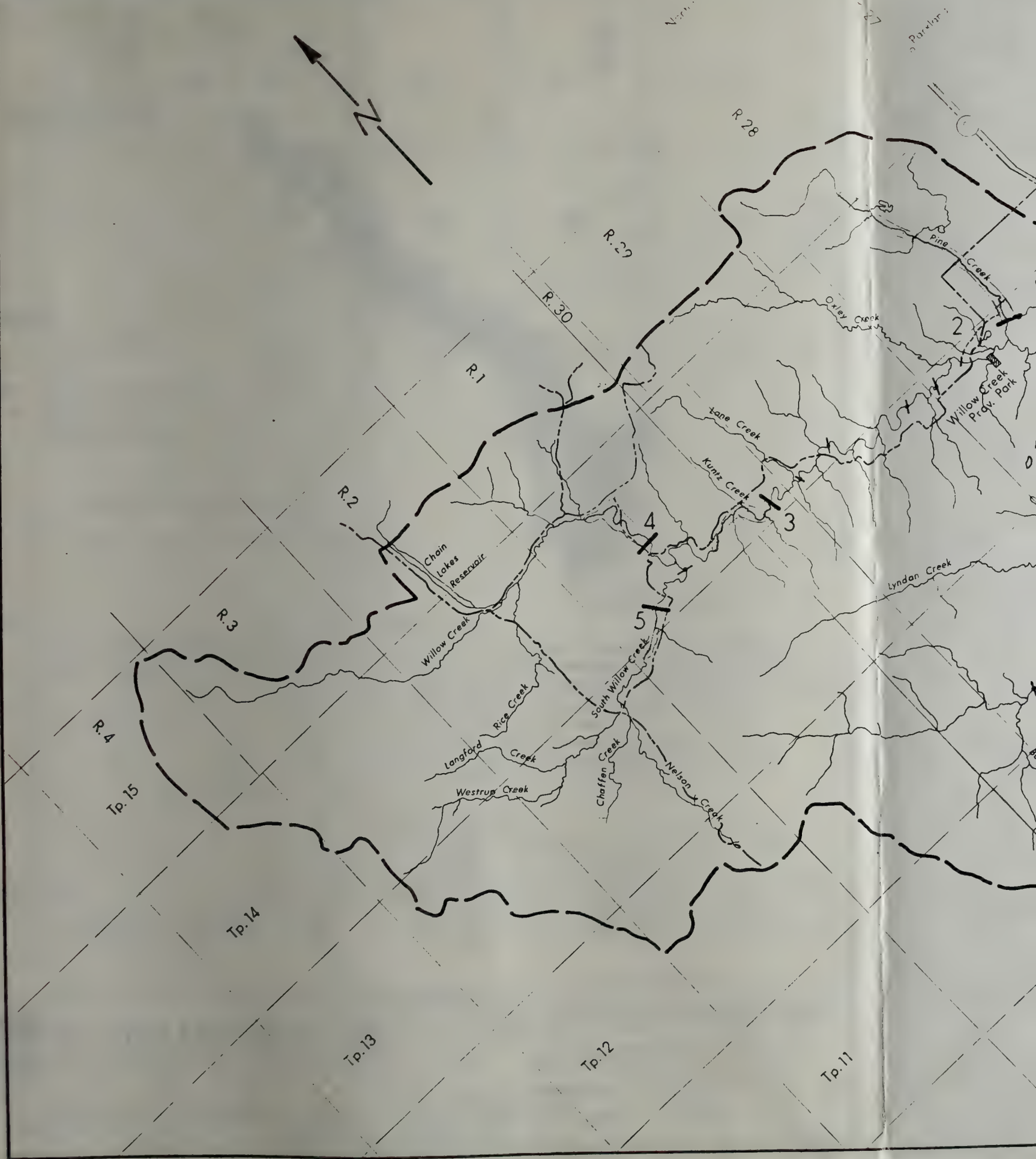
A new potential damsite near the original site 34 was identified during the field reconnaisance. This site was considered to be the best of all the sites on the southern tributaries (Trout Creek, Meadows Creek and Kayiskap Creek) as observed during the reconnaissance. It was selected so that the detailed comparison would include one site in the southern portion of the Willow Creek watershed.

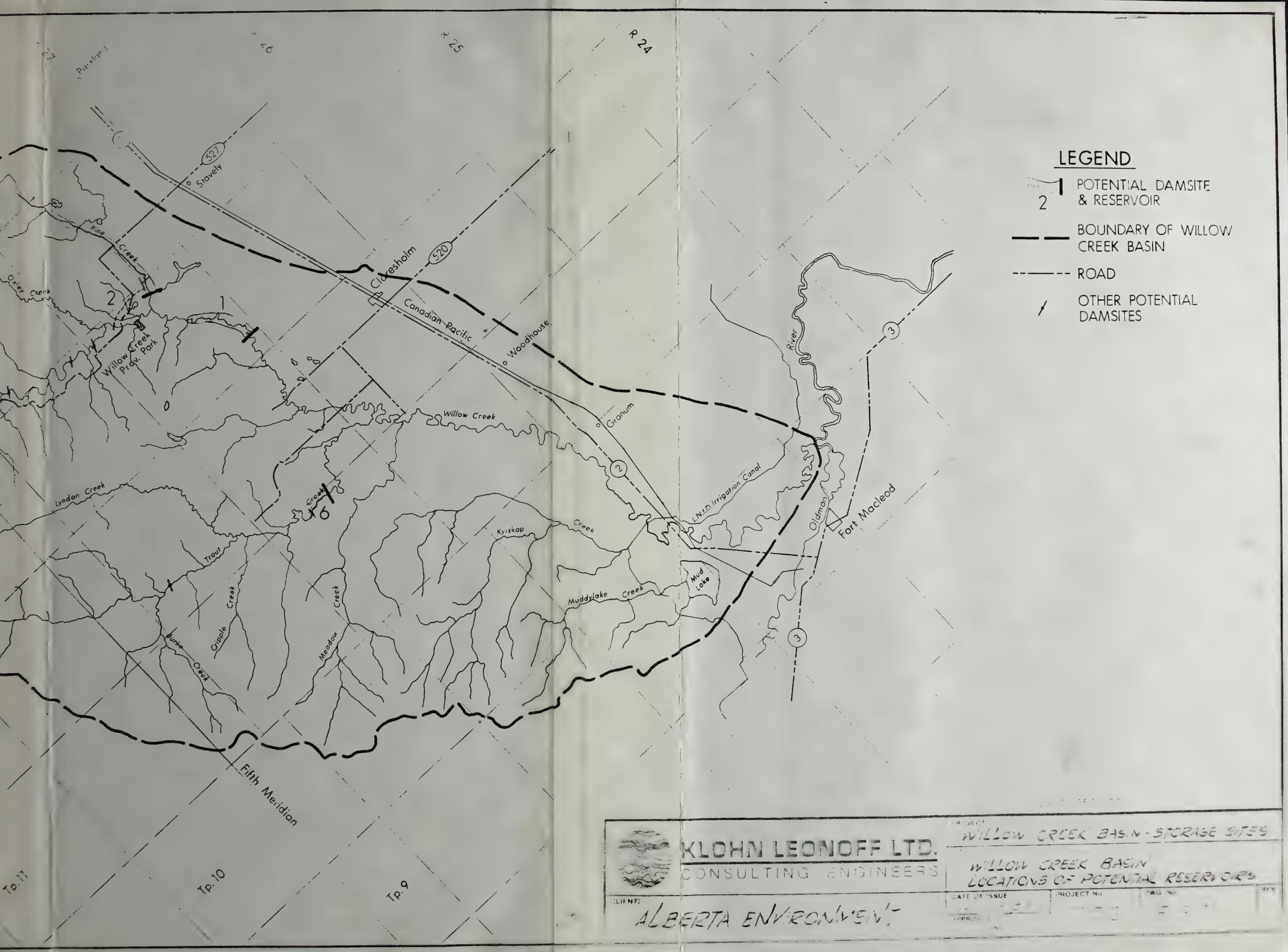
Ranger Station
Lakes
Creek
11
12
15
922
Campsite
PORCUPINE
HILLS
Furman
FORESTRY TRUNK ROAD
Pasque Mountain
Mount Livingstone
Isola Peak
CABIN RIDGE
RANGE
Beehive Mountain
WHALEBACK RIDGE
Fourth Base Line
IMPROVEMENT DISTRICT
Fire Tower
Maycroft
Tod Creek
North Fork
THUNDER MTN
7621
6957
6561
6340
7713
5245
5912
R
O
C
K


Gas Wells
Parkland
Microwave
529
Gas
Field
3238
527
2A
Stavely
3423
Clear
Lake
3393
3
Willow Creek
Provincial Park
CANADIAN
2
Pulteney
Oil Wells
20d
Radio
100'
Cypress
Lake
Carson
Lake
4th Base Line
3231
3166
Oil
Field
Claresholm
3292
520
Woodhouse
34
3476
WILLOW CREEK DISTRICT MUN
LETHBRIDGE CO
PORCUPINE
HILLS
Gratum
Microwave
302
CANADIAN PACIFIC
519
3154
Abandoned
Abandoned
Pearce
Macleod
Island
Fort Macleod
LIVERY

DRAWINGS

LIST OF DRAWINGS


N
R 28
R.29
R.30
R.1
R.2
R.3
R.4
Tp. 15
Tp. 14
Tp. 13
Tp. 12
Tp. 11
Pine Creek
Oxley Creek
Willow Creek Prov. Park
Lane Creek
Kuntz Creek
Chain Lakes Reservoir
Willow Creek
Lyndon Creek
South Willow Creek
Rice Creek
Langford Creek
Westrup Creek
Chaffen Creek
Nelson Creek
1
2
3
4
5



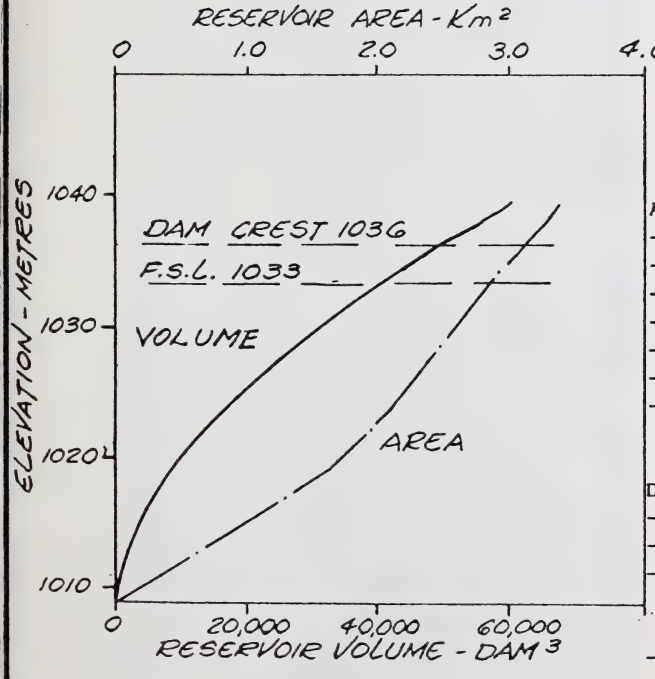
KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

WILLOW CREEK BASIN
LOCATIONS OF POTENTIAL RESERVOIRS

CLIENT: ALBERTA ENVIRONMENT

DATE OF ISSUE | PROJECT No. | DWG No.



ADVANTAGES
- close to towns of Stavely and Claresholm
- close to likely source of winter demand
- less likely for outflow to freeze up in winter
- relatively little reservoir damages
- recreation potential
- minimal apparent environmental impact
- relatively high regulated release rates (2.26/1.13 m^3/s summer/winter)

DISADVANTAGES
- possible instability of west valley wall
- possible pervious dam foundation
- reservoir cannot make targeted use of natural runoff (provides flow regulation for 50% of mean annual runoff relative to 60% targeted)
- Key Area for Mule Deer and White Tailed Deer

SCALE 1:50 000

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

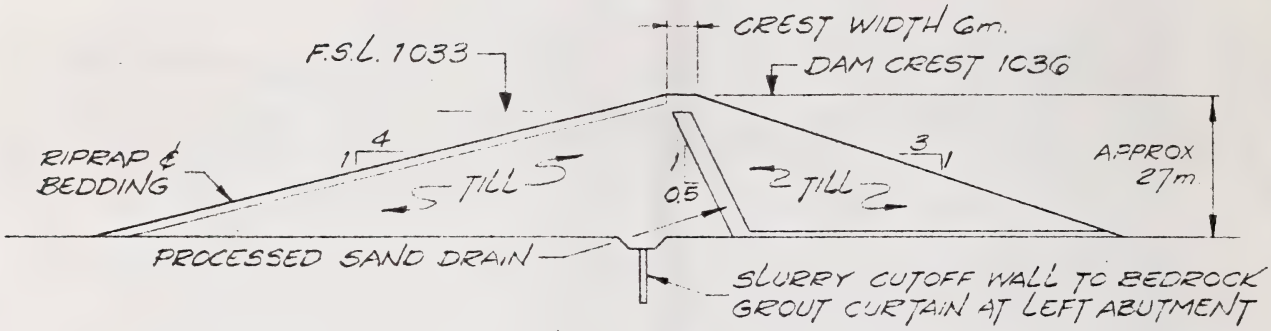
TITLE: SITE 1 - RESERVOIR DETAILS

CLIENT: ALBERTA ENVIRONMENT

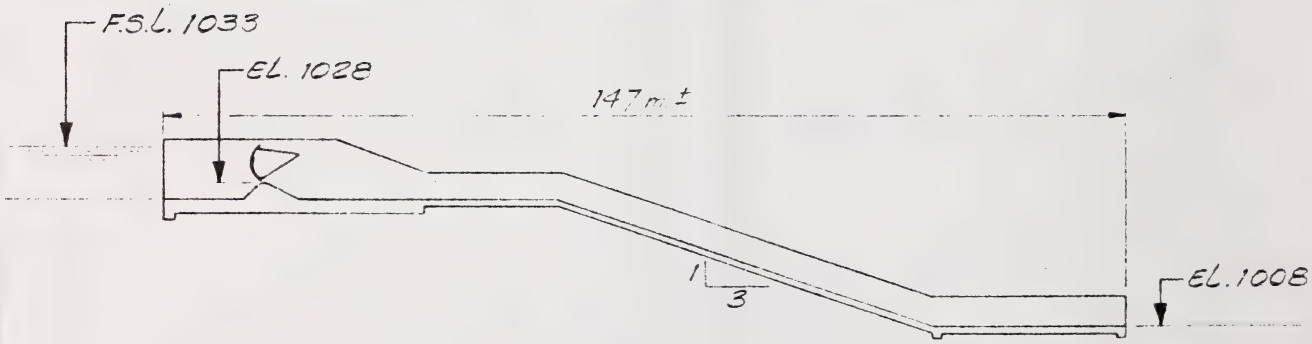
DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
JUNE 4/84	1956	FIG. 2	

APPROVED


N
DAM
SPILLWAY
DIVERSION TUNNEL &
LOW LEVEL OUTLET
OUTLET CHANNEL



CROSS-SECTION - DAM
SCALE - 1:125



℄ PROFILE - SPILLWAY
SCALE - N.T.S.

TO BE READ WITH KLOHN LEONOFF REPORT DATED June 4, 84

SCALE 1:5000 U.C.N.

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

TITLE: SITE 1 - GENERAL ARRANGEMENT & TYPICAL SECTIONS

CLIENT: ALBERTA ENVIRONMENT

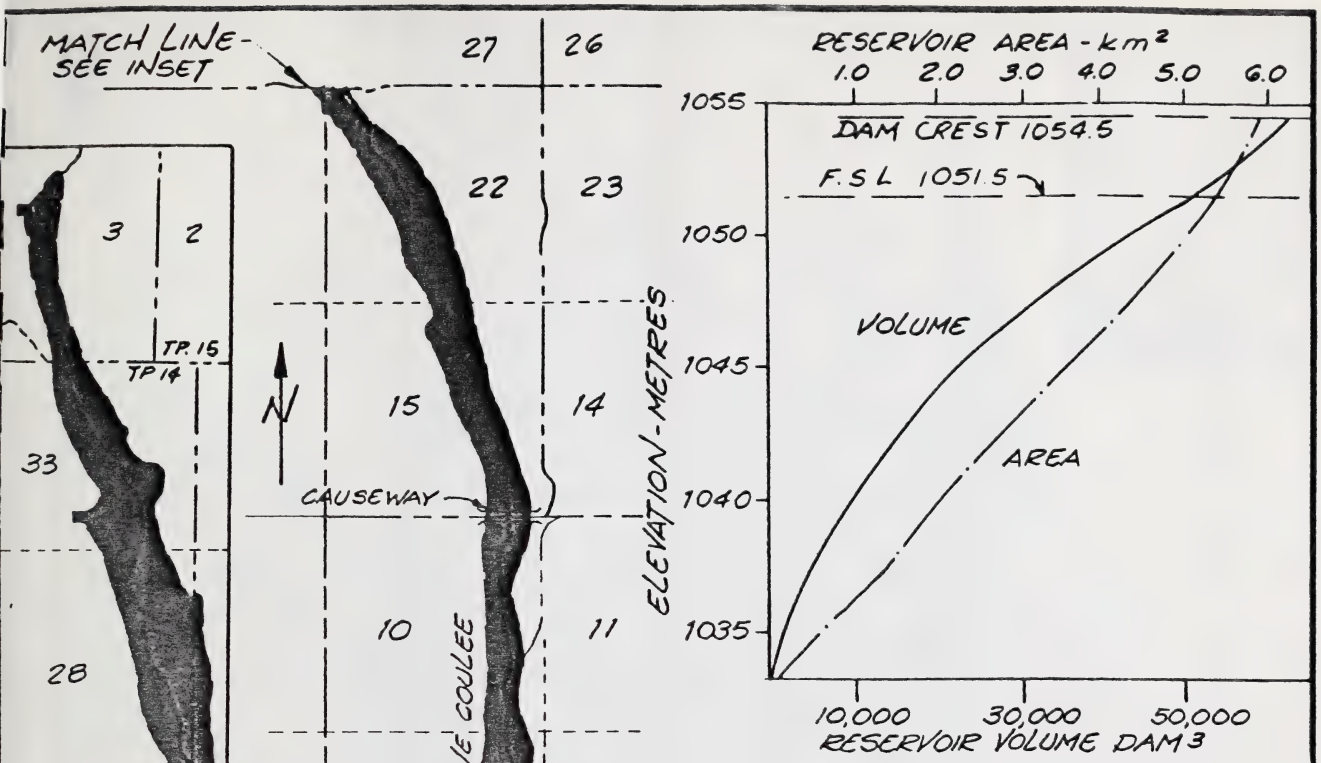
DATE OF ISSUE: June 4, 84

APPROVED:

PROJECT No.: 1956

DWG. No.: FIG. 3

REV:



ADVANTAGES

- major spillway not required
- low cost per unit of storage provided
- close to likely source of winter demand
- less likely for outflow to freeze up in winter
- recreation potential
- minimal apparent environmental impact
- close to towns of Stavely, Claresholm and Parkland
- relatively high regulated release rate ($2.42/1.21 m^3/s$ summer/winter)

DISADVANTAGES

- floods relatively large area of farmland
- soft valley floor foundation
- requires one major causeway and some road relocation
- Key Area for Mule Deer and White Tailed Deer
- reservoir cannot make targeted use of natural runoff (provides flow regulation for 54% of mean annual runoff relative to 60% targeted)

FOR LEGEND SEE FIG. 2

SCALE 1:50 000

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

TITLE: SITE 2 - RESERVOIR DETAILS

CLIENT: ALBERTA ENVIRONMENT

DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
JUNE 4/84	1956	FIG. 4	

APPROVED

WIER

DIVERSION DYKE

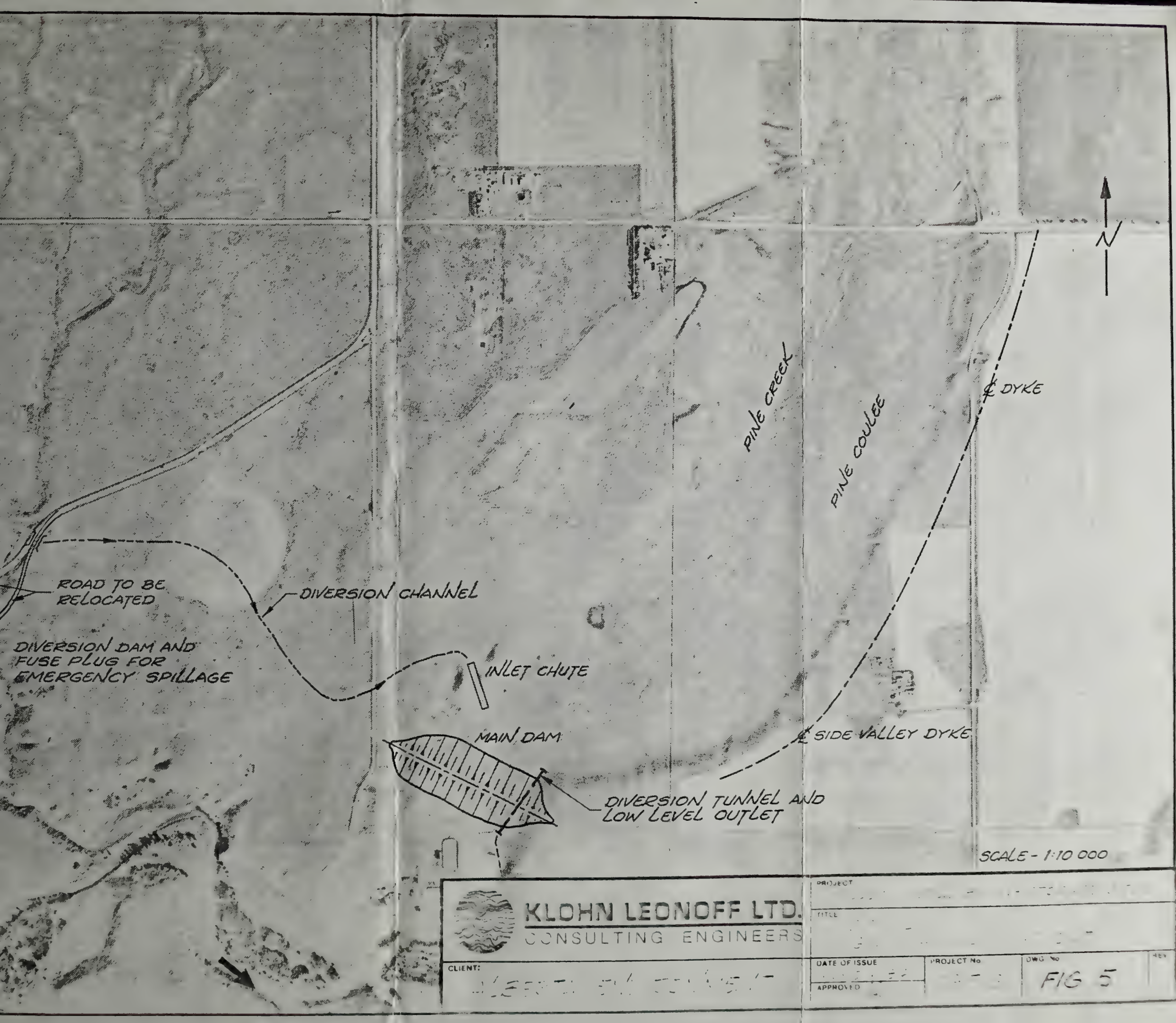
DIVERSION CHANNEL

DIVERSION DAM

ROAD TO BE RELOCATED

DIVERSION DAM AND FUSE PLUG FOR EMERGENCY SPILLAGE

WILLOW CREEK



SCALE - 1:10 000

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT

TITLE

CLIENT:

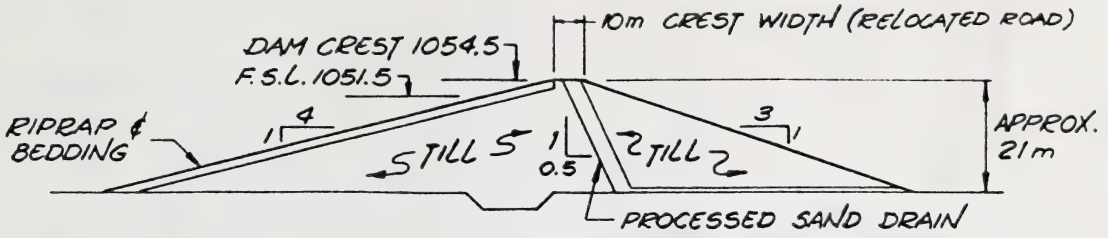
DATE OF ISSUE

PROJECT No

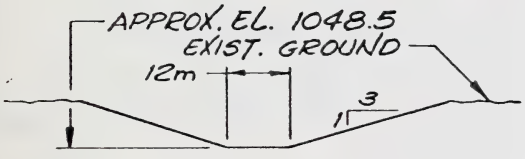
DWG No FIG 5

REV

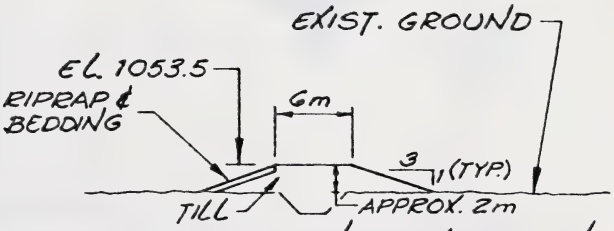
APPROVED



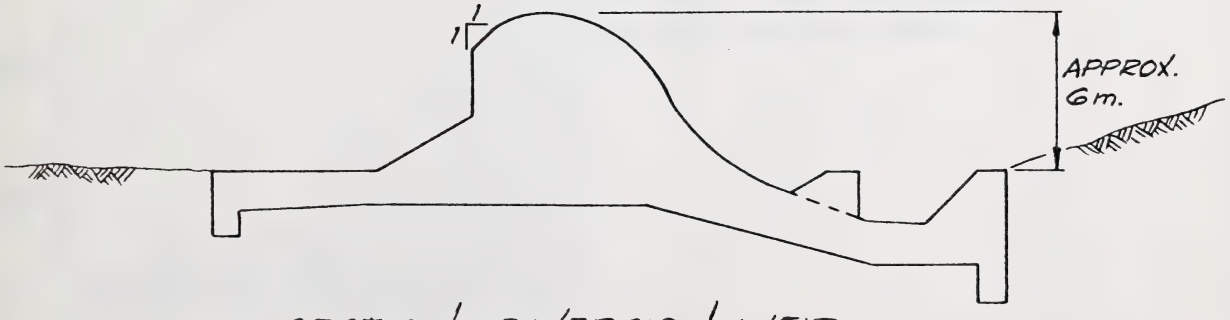
CROSS-SECTION - PINE COULEE DAM
SCALE - 1:125



CROSS-SECTION DIVERSION CHANNEL
SCALE - 1:125



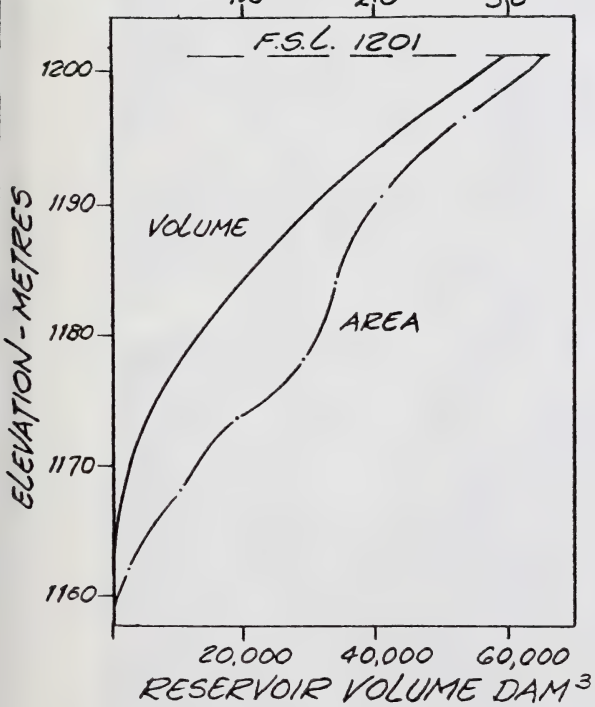
CROSS-SECTION - DIVERSION DYKE ON WILLOW CREEK
SCALE - 1:50



SECTION - DIVERSION WEIR
N.T.S.

SCALE AS NOTED

KLOHN LEONOFF LTD. CONSULTING ENGINEERS	PROJECT: WILLOW CREEK BASIN - STORAGE SITES			
	TITLE: SITE 2 TYPICAL SECTIONS			
CLIENT: ALBERTA ENVIRONMENT	DATE OF ISSUE: JUNE 4/84	PROJECT No.: 1956	DWG. No.: FIG. 6	REV.
	APPROVED			



ADVANTAGES
- low cost per unit of storage provided
- rock abutments
- no road relocation required
- provides flow regulation for 60% of mean annual runoff at site
- relatively high regulated release rates (2.44/1.22 m^3/s summer/winter)

DISADVANTAGES
- Key Area for Mule Deer and Elk
- may have impact on fisheries

FOR LEGEND SEE FIG. 2

SCALE 1:50 000

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

TITLE: SITE 3 - RESERVOIR DETAILS

CLIENT: ALBERTA ENVIRONMENT

DATE OF ISSUE: JUNE 4/84

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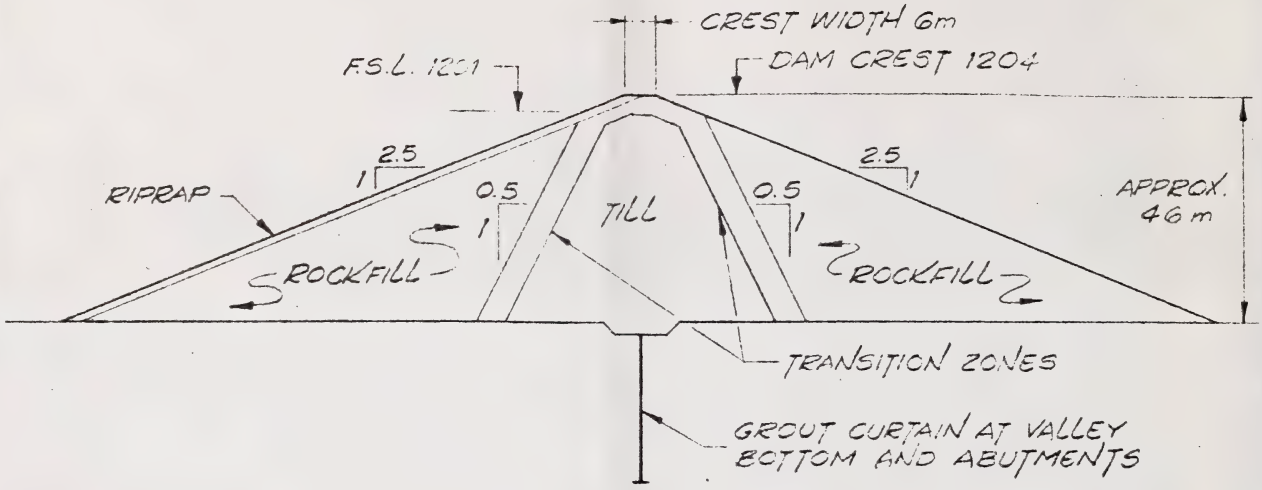
PROJECT No.: 1956

DWG. No.: FIG. 7

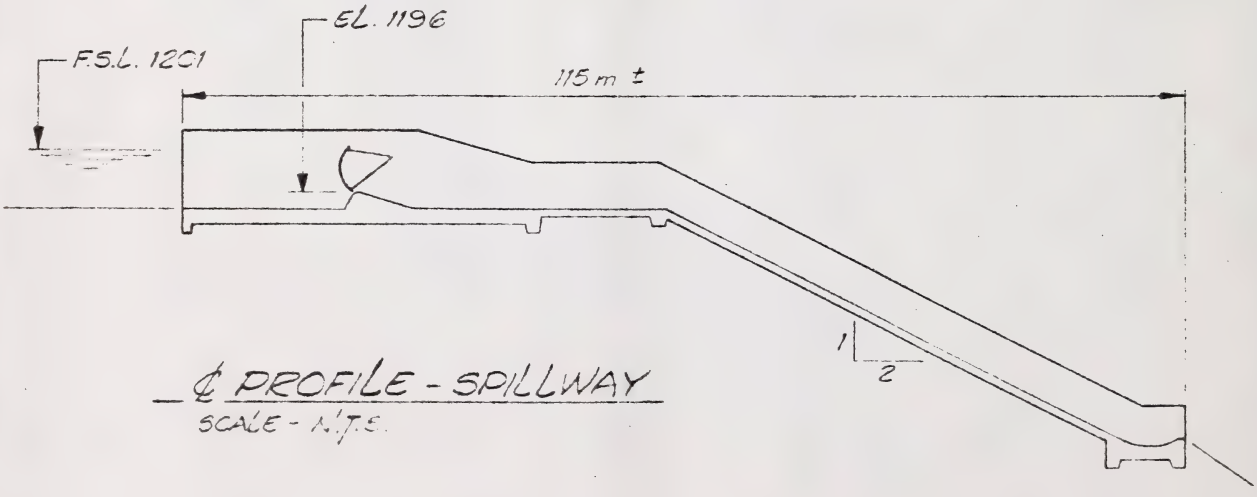
REV.:


N
WILLOW CREEK
SPILLWAY
DIVERSION TUNNEL & LOW LEVEL OUTLET
DAM



CROSS-SECTION - DAM

SCALE - 1:125



℄ PROFILE - SPILLWAY

SCALE - N.T.S.

TO BE READ WITH KLOHN LEONOFF REPORT DATED June 4, 84

SCALE 1:5000 U.C.N.

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

TITLE: SITE 3 - GENERAL ARRANGEMENT & TYPICAL SECTIONS

CLIENT: ALBERTA ENVIRONMENT

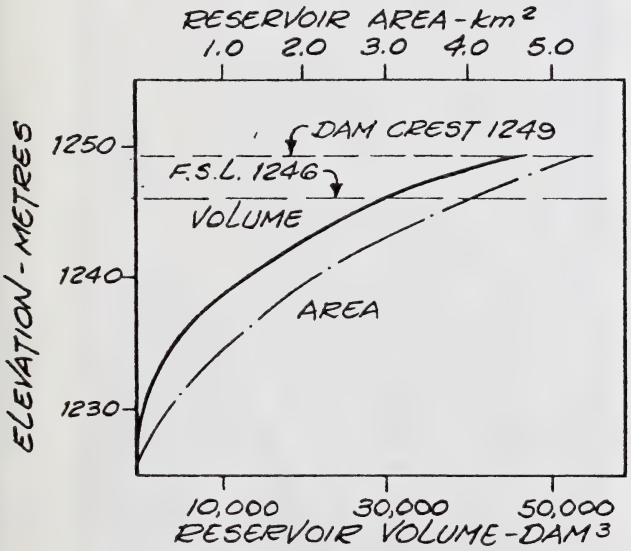
DATE OF ISSUE: June 4, 84

APPROVED:

PROJECT No.: 1956

DWG. No.: FIG. 8

REV.:



ADVANTAGES
- rock abutments
- provides flow regulation for up to 60% of mean annual runoff at site
- low cost per unit of storage provided

DISADVANTAGES
- floods two farmsteads
- extensive road relocation required
- requires new bridge
- may have impact on fisheries
- close to Chain Lakes

FOR LEGEND SEE FIG. 2

SCALE 1 : 50 000

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

TITLE: SITE 4 - RESERVOIR DETAILS

CLIENT: ALBERTA ENVIRONMENT

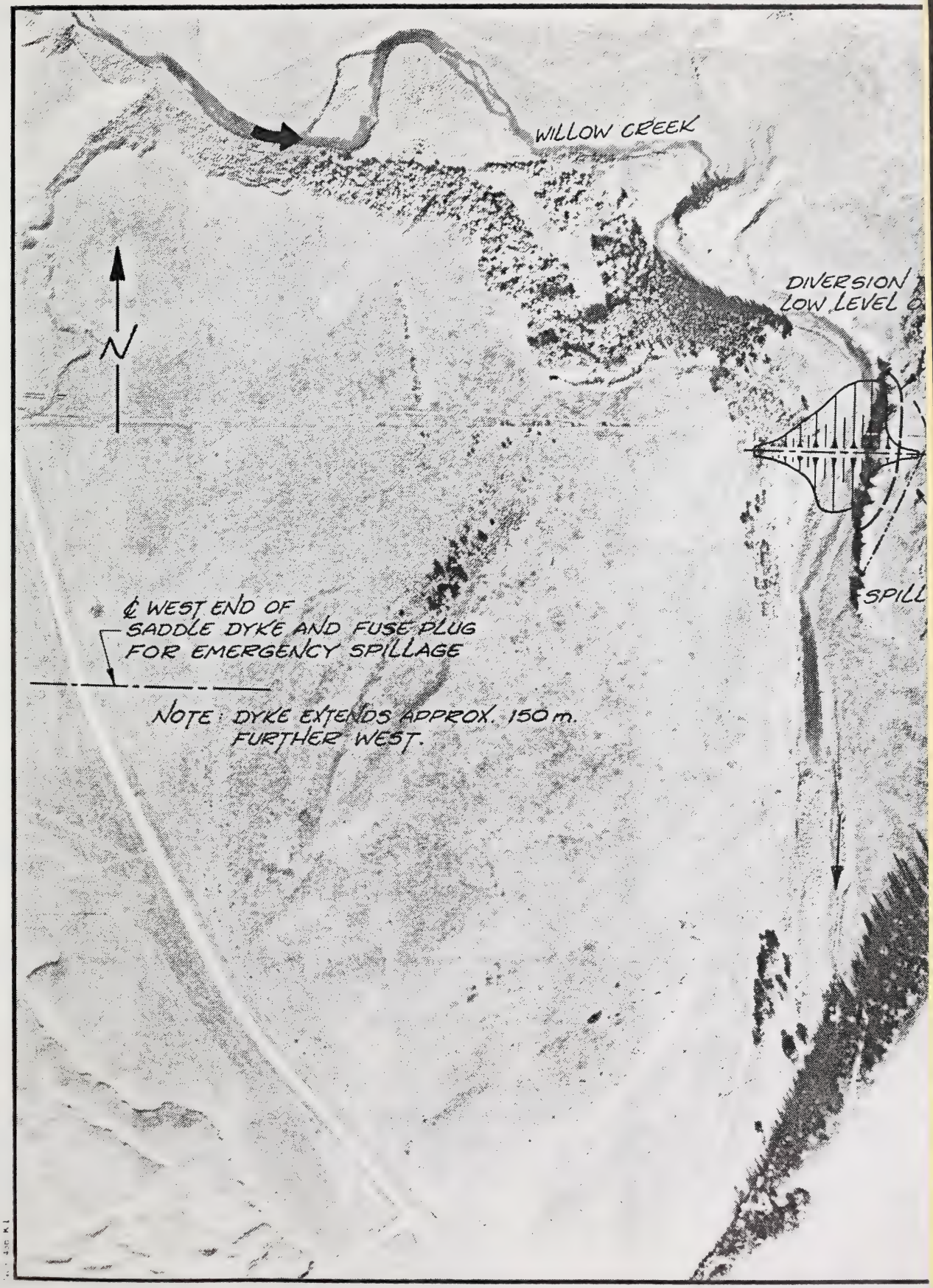
DATE OF ISSUE: JUNE 4/84

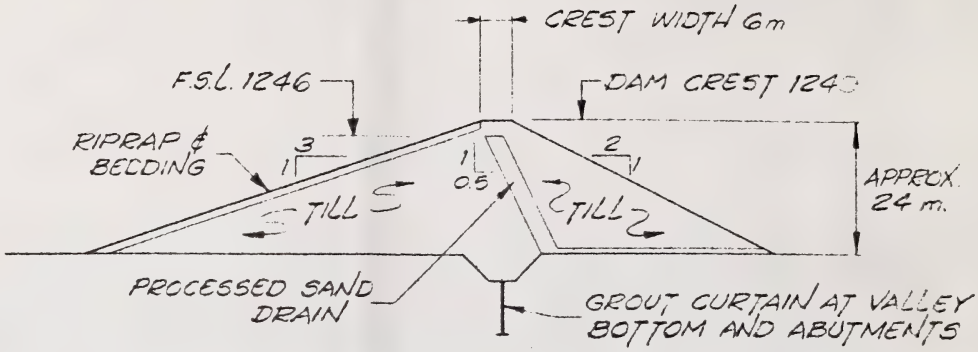
APPROVED:

PROJECT No.: 1956

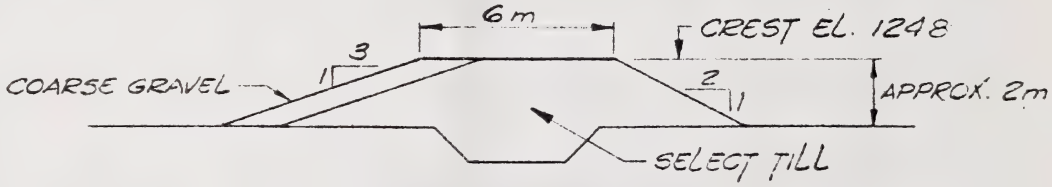
DWG. No.: FIG. 9

REV.:

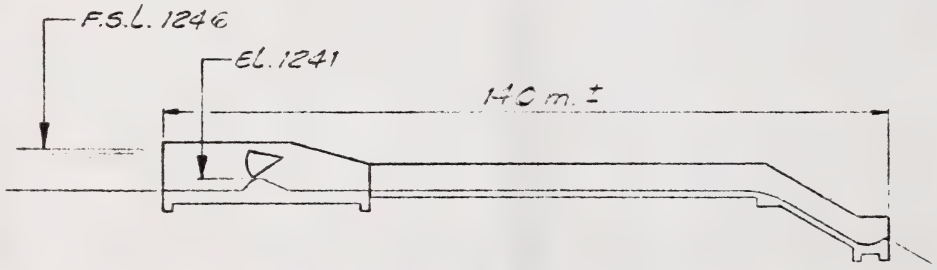

WILLOW CREEK
DIVERSION
LOW LEVEL O
SPILL
N
℄ WEST END OF
SADDLE DYKE AND FUSE PLUG
FOR EMERGENCY SPILLAGE
NOTE: DYKE EXTENDS APPROX. 150 m.
FURTHER WEST.



CROSS-SECTION - MAIN DAM
SCALE - 1:125



CROSS-SECTION - SADDLE DYKE
SCALE - 1:20



℄ PROFILE - SPILLWAY
SCALE - N.T.S.

TO BE READ WITH KLOHN LEONOFF REPORT DATED June 4/84

SCALE 1:5000 U.C.N.

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

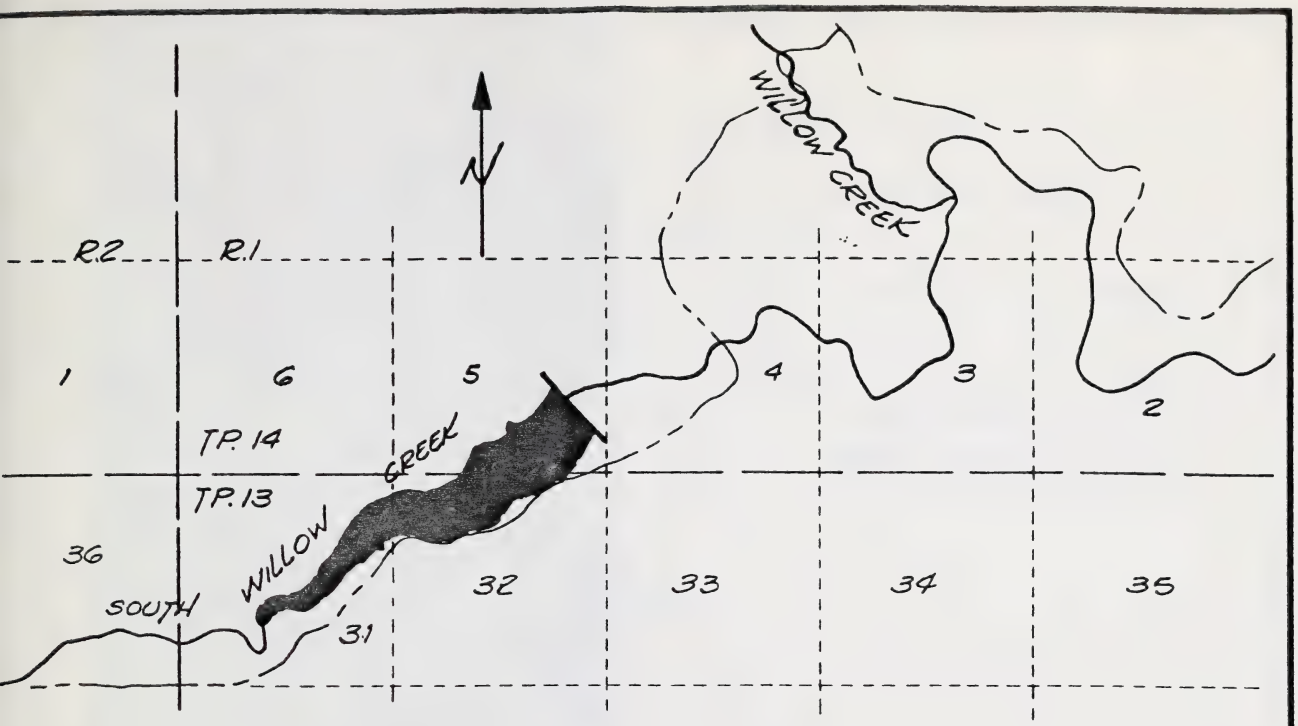
PROJECT: WILLOW CREEK BASIN - STORAGE SITES

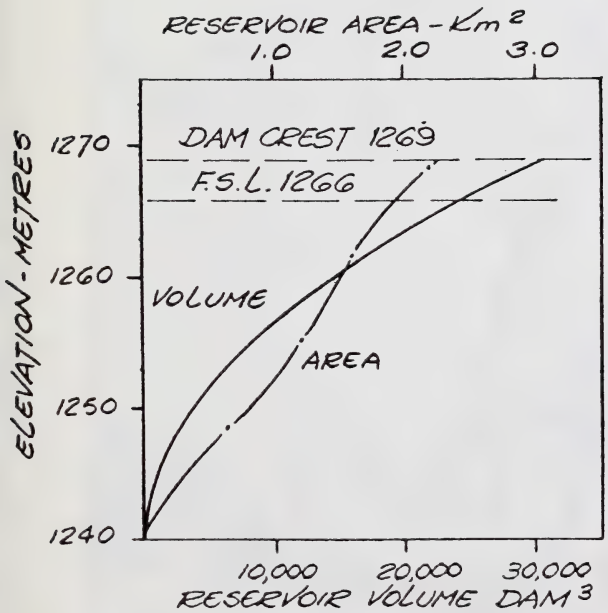
TITLE: SITE 4 - GENERAL ARRANGEMENT & TYPICAL SECTIONS

CLIENT: ALBERTA ENVIRONMENT

DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
June 4/84	1956	FIG. 10	

APPROVED





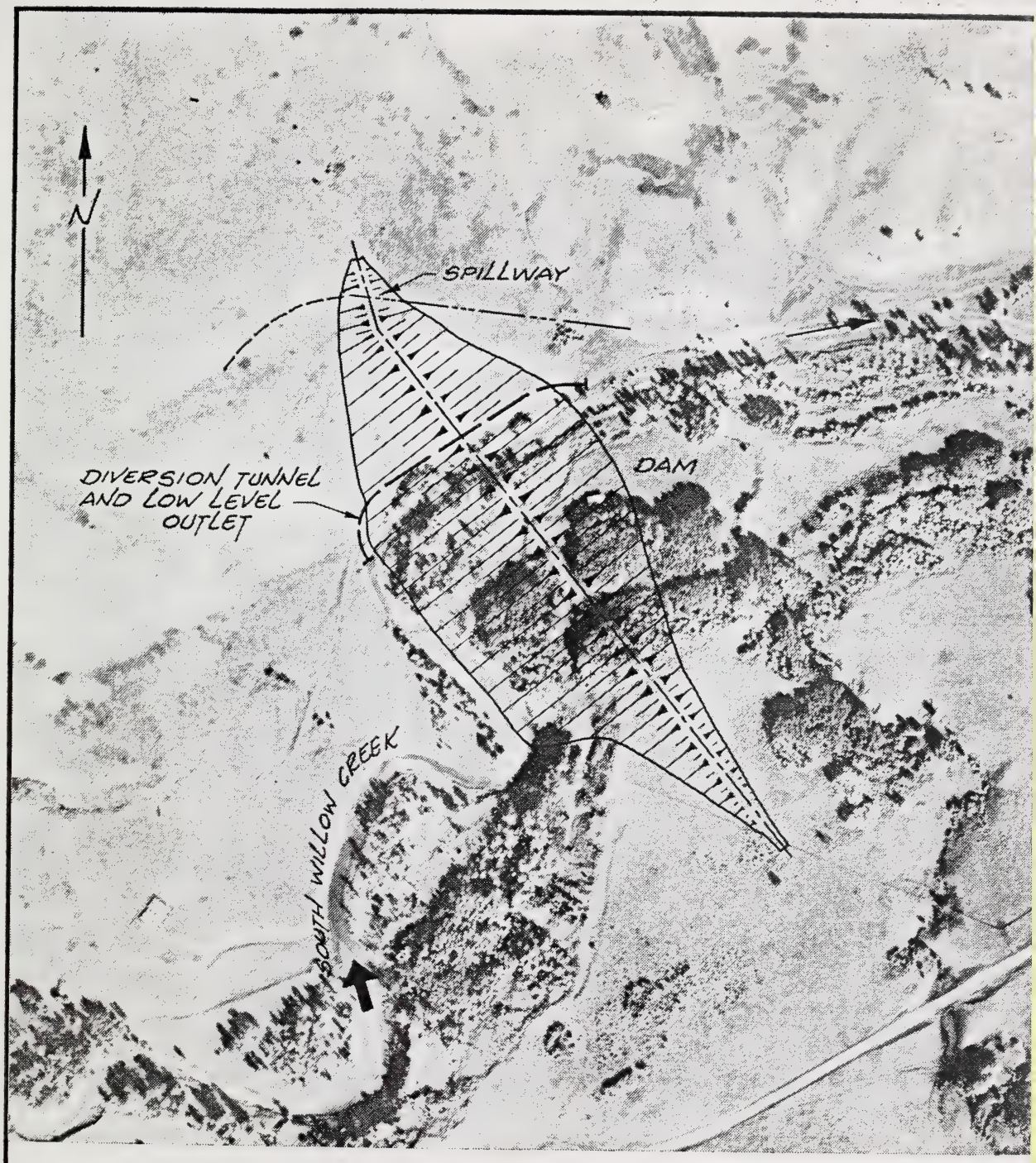
ADVANTAGES
- minimal reservoir damages
- provides flow regulation for up to 60% of mean annual runoff at site

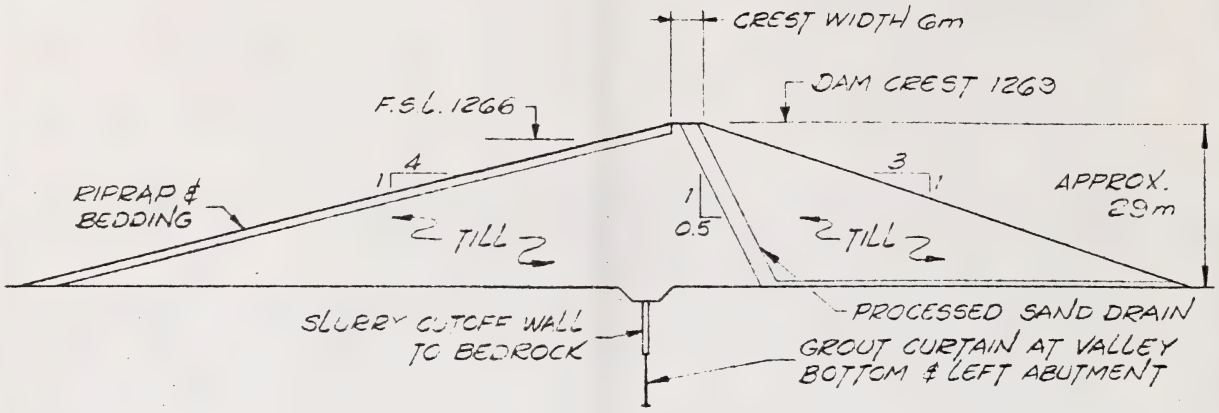
DISADVANTAGES
- Key Area for moose
- may have impact on fisheries
- high cost per unit of storage provided
- possible pervious foundation

FOR LEGEND SEE FIG. 2

SCALE 1 : 50 000

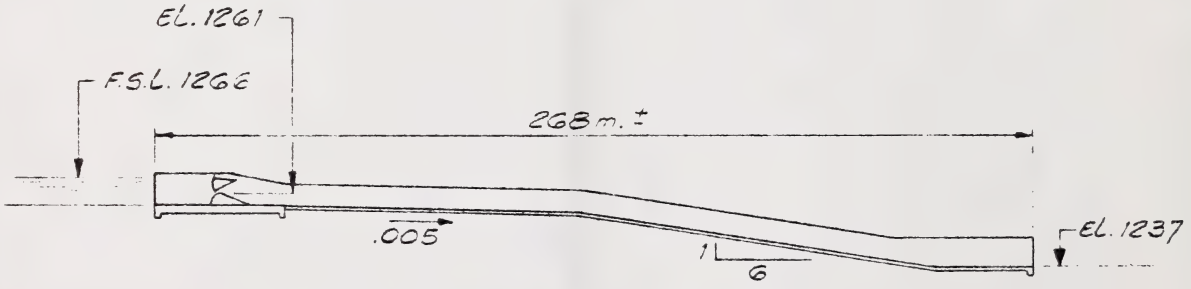
KLOHN LEONOFF LTD. CONSULTING ENGINEERS	PROJECT: WILLOW CREEK BASIN - STORAGE SITES			
	TITLE: SITE 5 - RESERVOIR DETAILS			
CLIENT: ALBERTA ENVIRONMENT	DATE OF ISSUE: JUNE 4/84 APPROVED:	PROJECT No.: 1956	DWG. No.: FIG. 11	REV.


N
SPILLWAY
DAM
DIVERSION TUNNEL
AND LOW LEVEL
OUTLET
SOUTH WILLOW CREEK



CROSS-SECTION - DAM

SCALE - 1:125



℄ PROFILE - SPILLWAY

SCALE - N.T.S.

TO BE READ WITH KLOHN LEONOFF REPORT DATED JUNE 4, 84

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KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

TITLE: SITE E - GENERAL ARRANGEMENT & TYPICAL SECTIONS

CLIENT: ALBERTA ENVIRONMENT

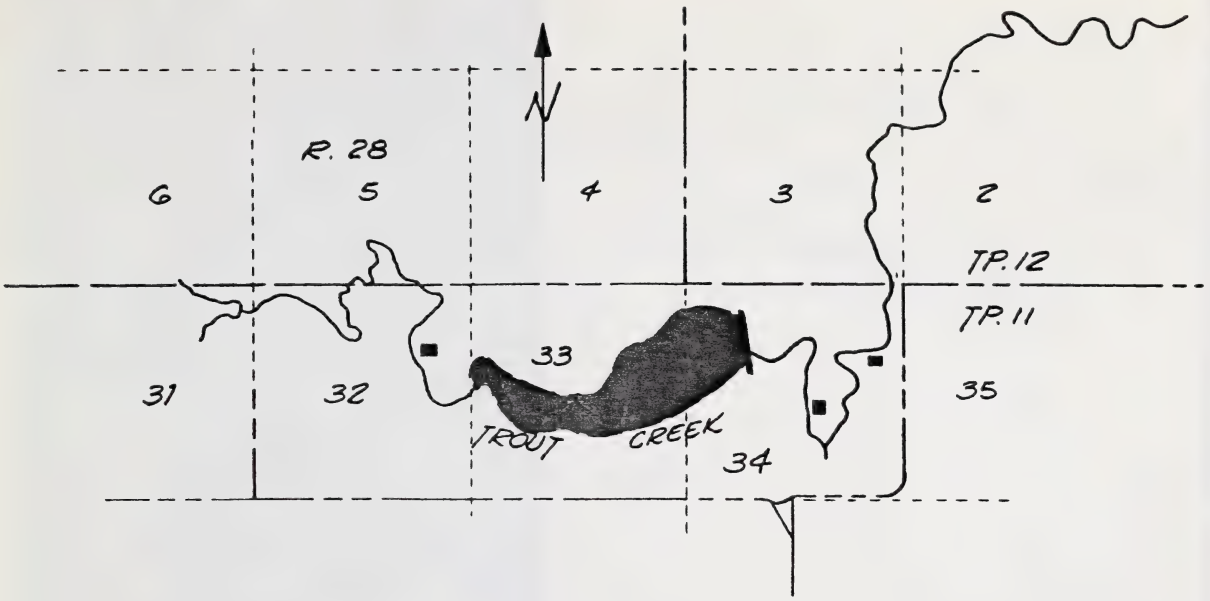
DATE OF ISSUE: JUNE 4, 84

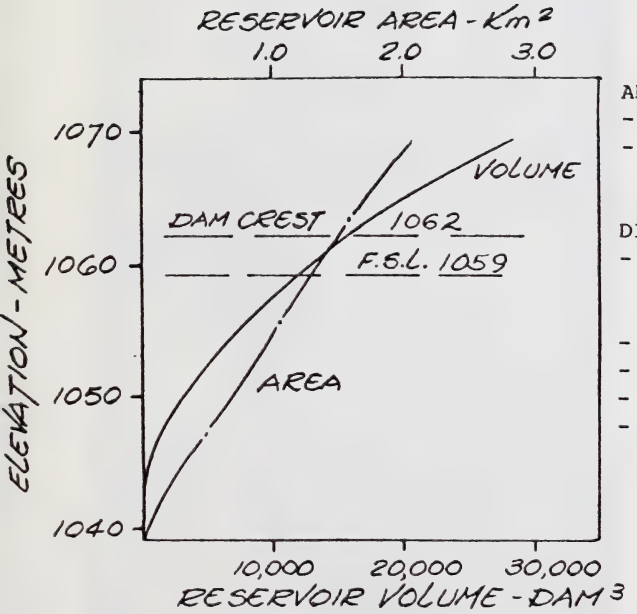
APPROVED:

PROJECT No.: 1956

DWG. No.: FIG 12

REV:





ADVANTAGES
- minimal reservoir damages
- less likely for outflow to freeze up in winter

DISADVANTAGES
- Key Area for Sharp Tailed Grouse, Great Blue Heron, Mule Deer and White Tailed Deer
- may have impact on fisheries
- possible pervious foundation
- relatively low regulated release rates
- reservoir cannot make targeted use of natural runoff (provides flow regulation for about 50% of mean annual runoff relative to 60% targeted)

FOR LEGEND SEE FIG. 2

SCALE 1:50 000

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

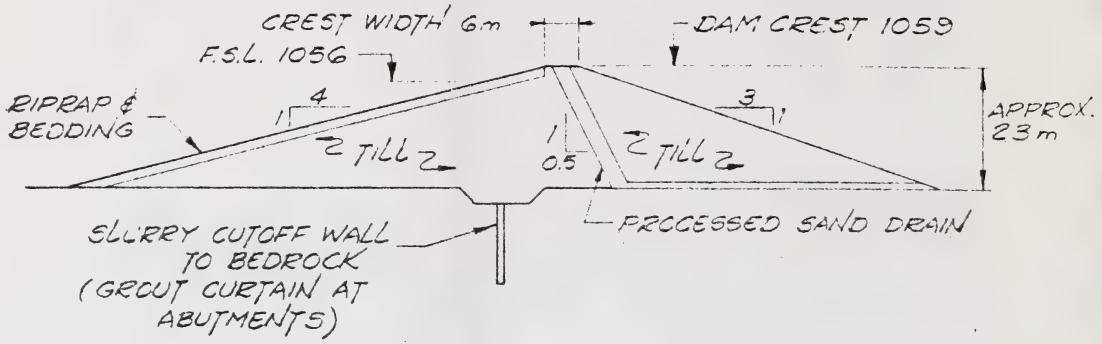
TITLE: SITE 6 - RESERVOIR DETAILS

CLIENT: ALBERTA ENVIRONMENT

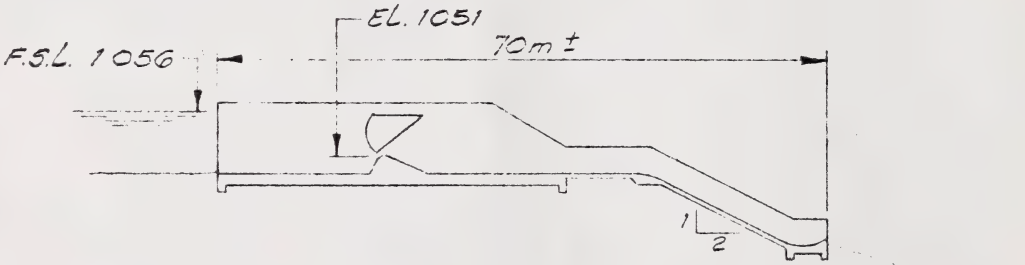
DATE OF ISSUE	PROJECT No.	DWG. No.	REV.
JUNE 4/84	1956	FIG. 13	

APPROVED


N
DIVERSION TUNNEL & LOW LEVEL OUTLET
OUTLET CHANNEL
DAM
SPILLWAY



CROSS-SECTION - DAM
SCALE - 1:125



℄ PROFILE - SPILLWAY
SCALE - N.T.S.

TO BE READ WITH KLOHN LEONOFF REPORT DATED JUNE 4/81

SCALE 1:5 000 U.C.N.

KLOHN LEONOFF LTD.
CONSULTING ENGINEERS

PROJECT: WILLOW CREEK BASIN - STORAGE SITES

TITLE: SITE 6 - GENERAL ARRANGEMENT & TYPICAL SECTIONS

CLIENT: ALBERTA ENVIRONMENT

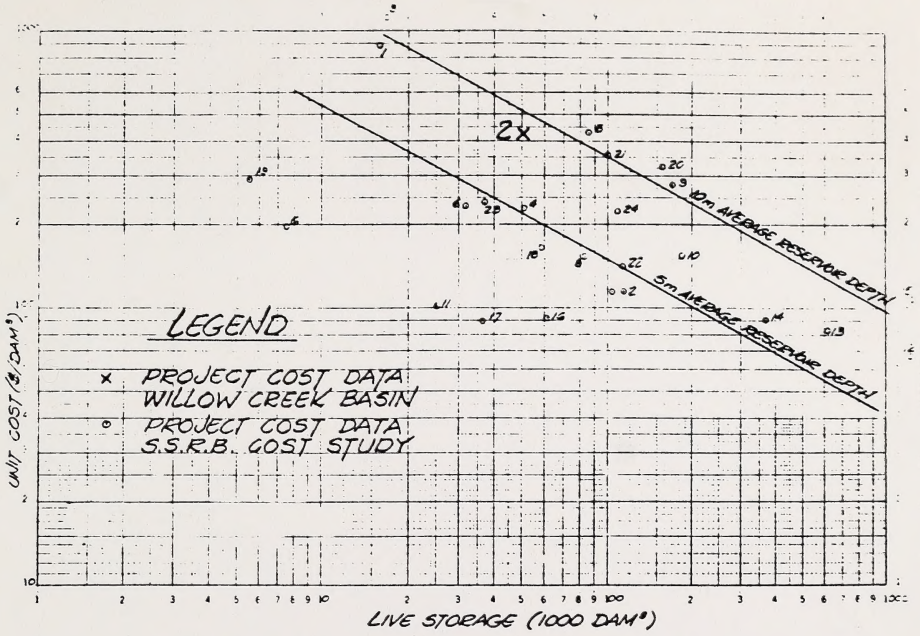
DATE OF ISSUE: JUNE 4/81

APPROVED:

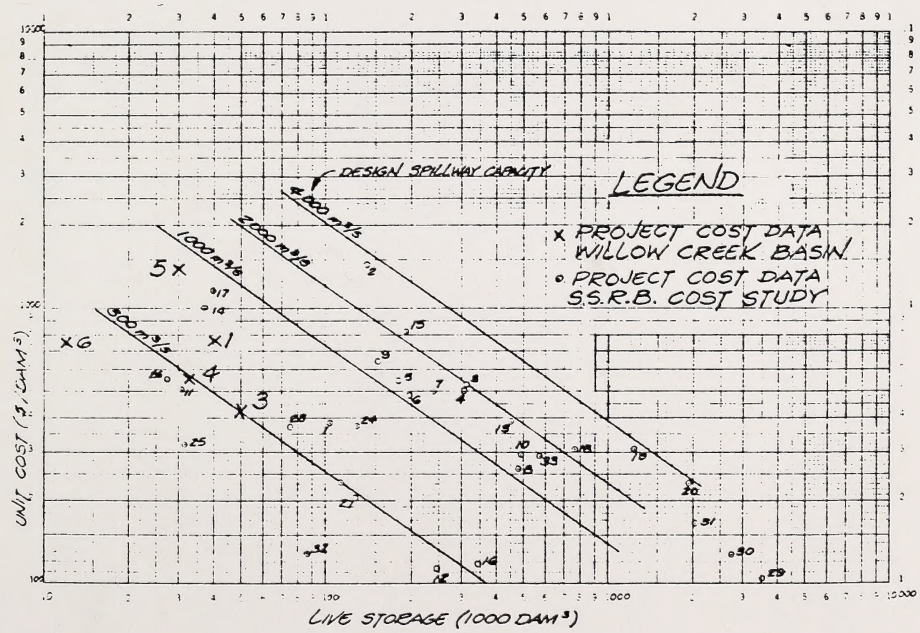
PROJECT No. 1956

DWG. No. FIG. 14

REV.



CAPITAL COST OF OFFSTREAM RESERVOIRS



CAPITAL COST OF ONSTREAM RESERVOIRS

COST COMPARISON FIG.15